DeREMER WATER WHEELS

The
DeRemer Water Wheel
Company

Denver, Colorado, U. S. A.

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EDITION 1906

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The DEREMER Water Wheel

EMBRACING IN ITS DESIGN *and* APPLICATION

The DeRemer System *of* Water Power

PATENTED IN THE UNITED STATES AND FOREIGN COUNTRIES

MANUFACTURED ONLY BY

JARED R. *and* JAMES S. DeREMER

Engineers *and* Contractors

DENVER, COLO.

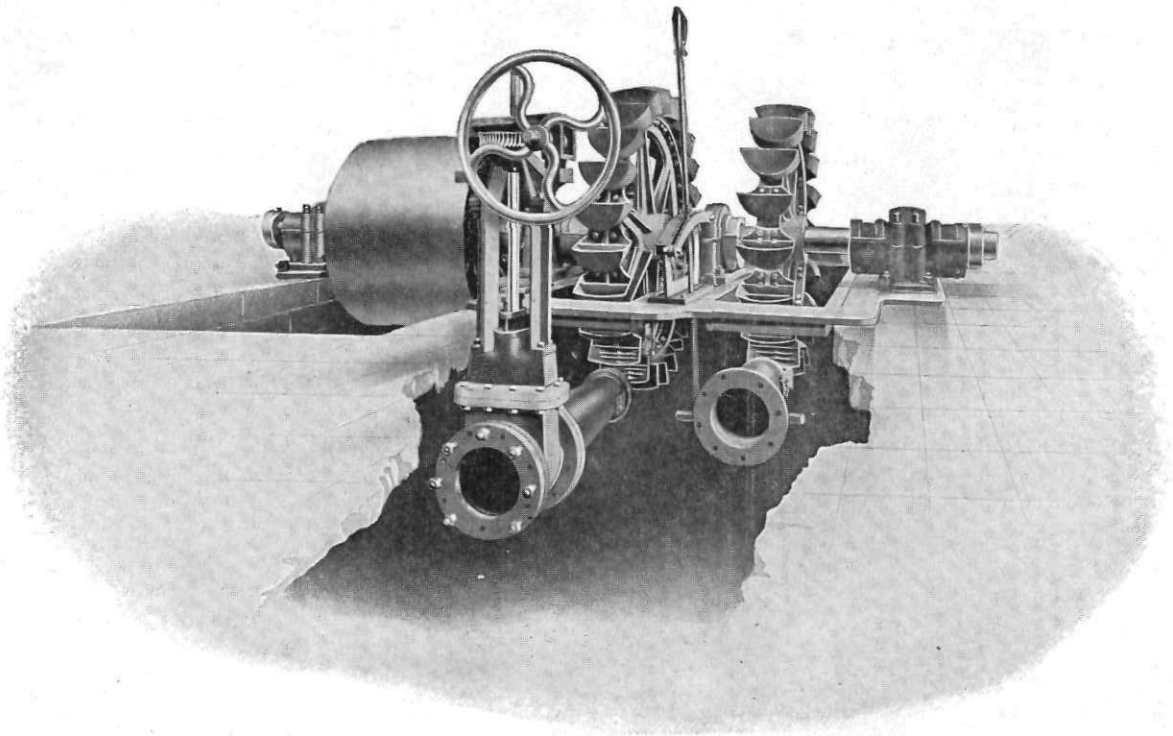
U. S. A.

Residence:
GLENWOOD SPRINGS, COLORADO

Cable Address: "DeRemer, Denver"
Use Western Union Code

THIRD EDITION, INCLUDING BULLETIN No. 8

THE SMITH-BROOKS PRESS, DENVER.



Manufactured and Installed for The Hercules Mining Co., Burke, Idaho.

The cut shown on preceding page represents a most unique plant of DeRemer Water Wheels installed for the HERCULES MINING CO., BURKE, IDAHO. The water wheels are of different diameters, mounted on one shaft uniting two mountain streams into one unit of power. The Five-Foot Bronze wheel works under a net head of eight hundred (800) feet and the Four-Foot wheel under a net head of four hundred and fifty-four (454) feet. The difference in the diameters of the two water wheels were arranged by Mr. DeRemer in order to produce a uniform speed under the different vertical heads. This cut represents our "style C" wheel mounting, consisting of cast baseplate and steel top housing.

Engineers say of this installation: "Extremely unique in design, perfect in material and workmanship and the king of them all in efficiency."

When the fact is taken into consideration that one of the best known Water Wheel companies in the world installed the two pipe lines and that the DeRemer Water Wheel Co. installed the two water wheels, there can be but one conclusion: the superiority of the DeRemer water wheel.

THE DE REMER WATER WHEEL TALKS FOR ITSELF! THE FOLLOWING TESTIMONIAL CAME TO US UNSOLICITED:

"Hercules Mining Company

BURKE, IDAHO, NOVEMBER 14th, 1905.

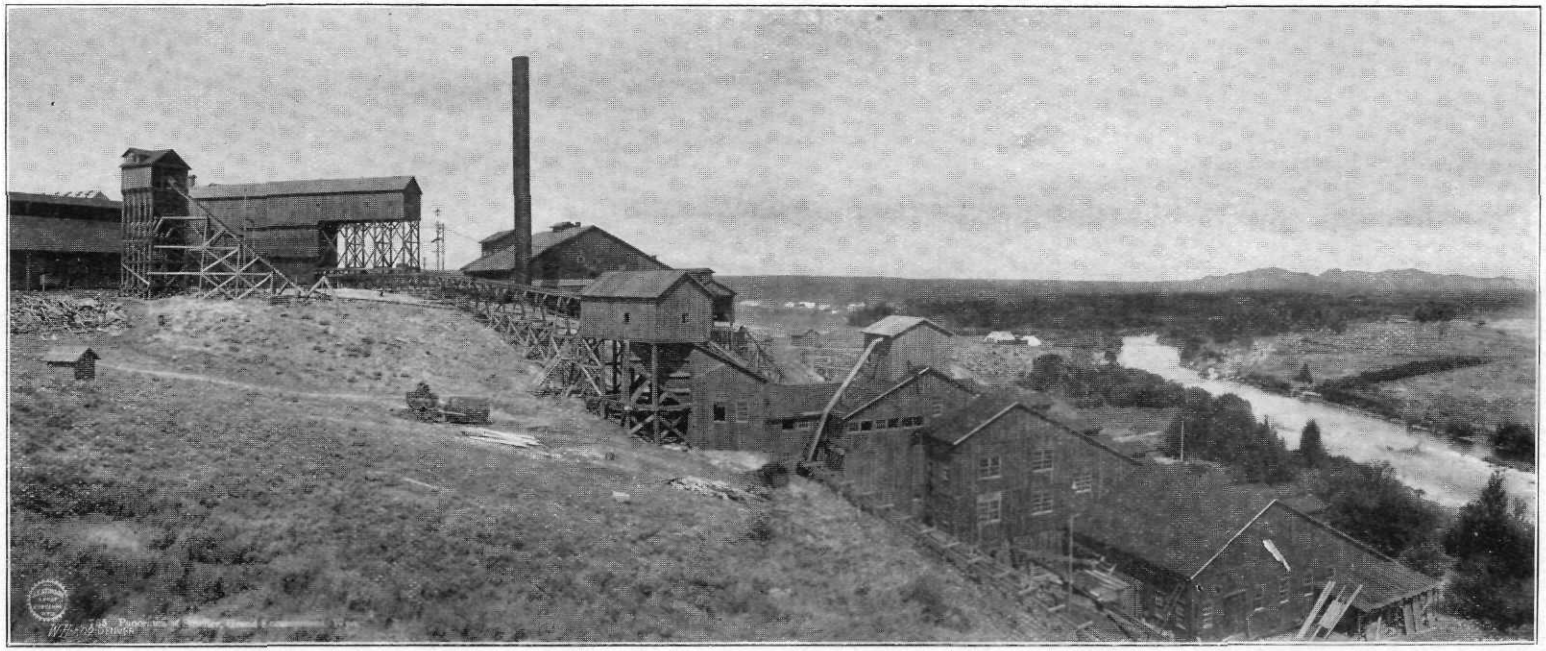
Mr. Harry L. Corbett, Mgr.,
United Light & Power Co.,
Georgetown, Colorado.

Dear Sir:

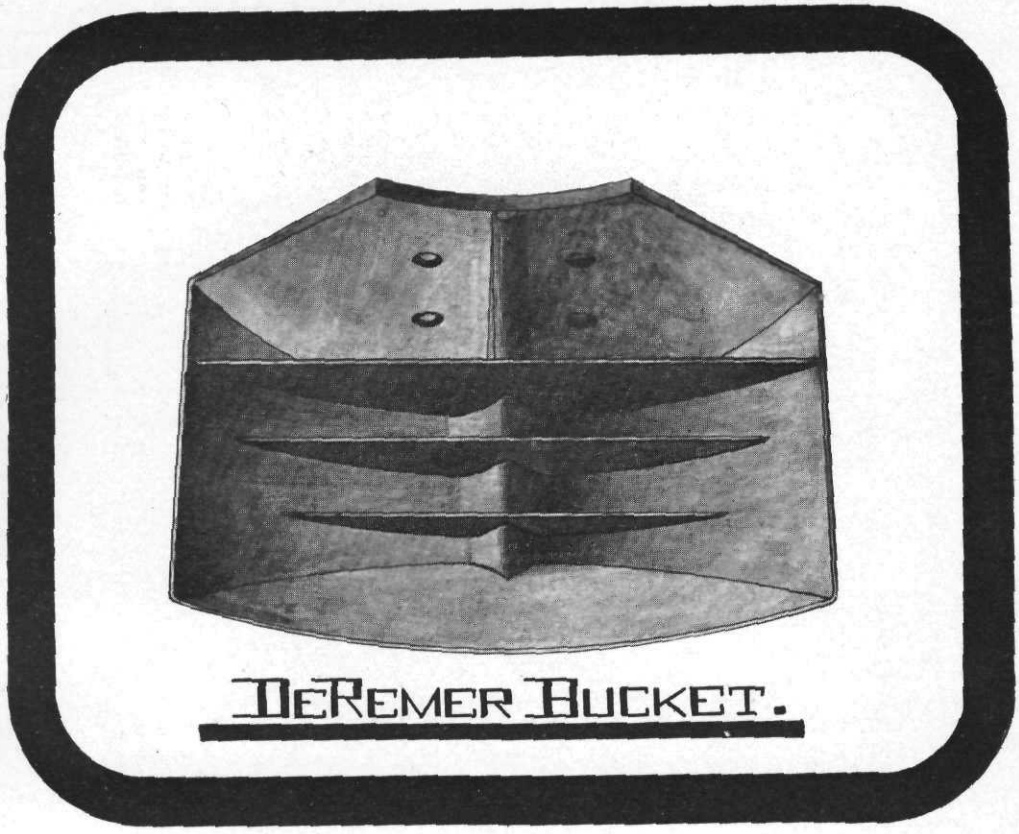
We have been requested by the Mine & Smelter Supply Co., Denver, Colorado, to acquaint you with our experience with the DeRemer Water Wheel. We think it only fair to state that we installed two DeRemer wheels about two years ago, and they have given excellent satisfaction ever since. The five foot wheel works under a head of Eight Hundred Feet (800 ft.) and the four foot wheel under a head of four hundred and fifty feet (450 ft.); both wheels are mounted on One Shaft, and in addition to the regular worm gear valves, are throttled by cut-off hoods worked by lever and quadrant for each wheel. Our total expense for the entire time which these wheels have been in service is the cost of one new bucket. The Horizontal Splitters which distinguish this type of wheel from other impact wheels, is, in the opinion of the writer, the best device for obtaining the full power of the stream which has yet been invented. I might say in addition that the guarantee originally made by the DeRemer Company as to the efficiency and performance, have been fully complied with in every particular. Yours very truly,

(Signed) THE HERCULES MINING COMPANY,
HARRY L. DAY, Manager."

10-4-90 Donald - Carolyn Moki 914



The above cut shows the eastern end of the sixteen-mile aerial tramway delivering ore into the ore houses; the mill, smelter, electric plant and power house of the North American Copper Co., Encampment, Wyoming, operated by DeRemer water wheels. The water power consists of: 22,400 feet of 50-inch hydraulic steel pipe; two four-foot, seven five-foot and three six-foot DeRemer water wheels operating under an effective head of 110 feet, with a capacity of 2,700 horsepower. While the horsepower is less than that of a few other plants, it is the largest single installation of tangential water wheels in the United States.



DeREMER BUCKET.

INTRODUCTION

In the compilation of this, the Third Edition of the DeRemer Catalog, including Bulletin No. 8, we aim to present to the uninitiated in water power installation a concise description of the primary principles and general functions of the DeRemer Water Wheel, together with its adaptability to all conditions met with in water power practice.

We have conducted exhaustive tests with both the small water motors and large power wheels, and have made comparative tests against other well known wheels, and hereby truthfully state that in each and every case with small motors and large power wheels, the DeRemer line of efficiency was 7% to 18% higher than that of any other water wheel. These tests were made against the best known wheels in the market.

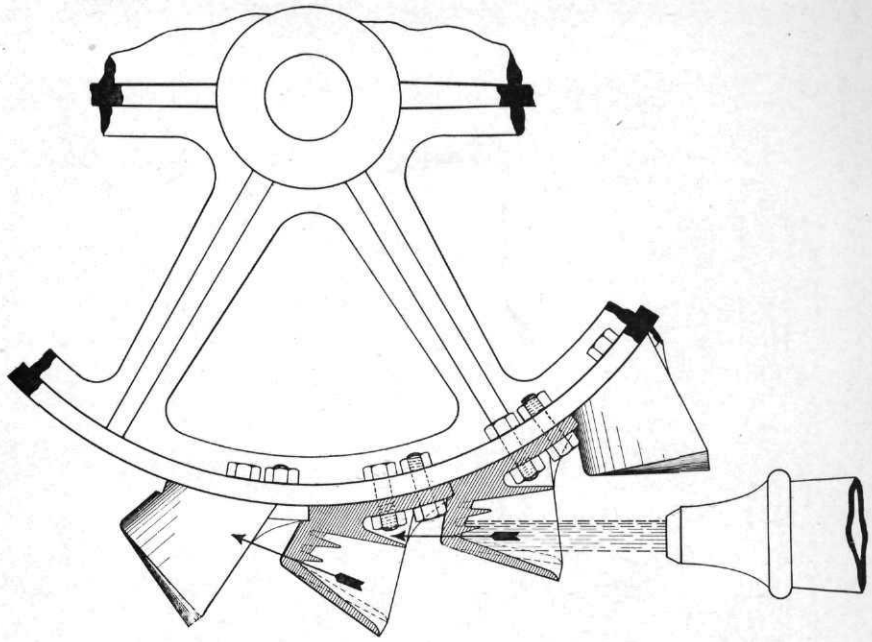
All claims made by us of a "higher efficiency" are susceptible of practical demonstration.

This company has built water wheels for many years. Our wheels have displaced many others of various makes, both turbine and tangential. Other well known wheels have been equipped with DeRemer buckets and the efficiency raised materially. Our practical experience has suggested improvements and betterments which have been taken advantage of—this is applicable to the material used, design and workmanship.

The DeRemer buckets are made of selected cast iron, semi-steel, gun metal steel or phosphor bronze castings as may be required. These latter qualifications, combined with a proper adaptation to the work to be performed, are the prime requisites of a water power installation.

Our modern hydro-electric power generation lead to great improvements in water wheels. The old style, as far as efficiency is concerned, have passed into history.

During the year 1904 the DeRemer Water Wheel Co. **installed more water wheels in the Northwest—Idaho, Oregon, Washington and British Columbia**—than all other water wheel companies combined. This fact has but one conclusion: the superiority of the DeRemer water wheel.



Section of Wheel Showing Nozzle and Stroke Tangential to Circumference.

The DeRemer System *of* Water Power

In tangential water wheels, the effective dynamic pressure in causing rotation is that which is tangential to the circumference of revolution. The arrangement of the Horizontal Splitters in the DeRemer bucket is such that the force of impact of the water is tangent to the circumference of the wheel and a maximum efficiency results. No other wheel is so constructed, hence no other wheel is so efficient.

We call to the special attention of Hydraulic Engineers the "Horizontal Splitters," fully covered by United States and foreign patents. These splitters are so arranged that when impingment takes place the line of force is continuously tangent to the wheel circumference during the passage of the bucket through the stream from which a maximum efficiency results.

It will be called to mind that during all the ages, and up to about the advent of the DeRemer water wheel, water was considered inelastic. Recent research has fully demonstrated that water is one hundred times more elastic than steel. The construction of the DeRemer bucket complies with the DeRemer theory that in order to develop the highest efficiency water must be stopped as far as its contact with the bucket is concerned, and the discharge of the dead water be made by gravity and centrifugal force. The water coming in contact with the DeRemer bucket is compressed between the wedge-shaped horizontal splitters, at which moment the elastic reaction transmits all of the inertia to the wheel and the dead water follows in suspense, so to speak, and is discharged at the sides and straightaway on line with the inlet. On account of this discharge the DeRemer water breaks were introduced.

Three carefully conducted tests have been made which clearly demonstrated the DeRemer the most powerful water wheel on the market. One by Prof. R. C. Carpenter, Cornell University, Ithaca, New York; one by G. D. Harrington, of New Jersey, and one by Theo. Rosenberg, of Colorado, engineers of high repute throughout the United States. The DeRemer has been subjected to trying tests of actual use under widely varying conditions and has successfully shown its adaptability and superiority. The following points cover the DeRemer theory:

First—The "V" shaped horizontal splitters stop the stream of water dead after issuing from the jet, overcoming that "glancing" blow ever present in feeding a circle through a tangent, and characteristic of all other forms of tangential wheels.

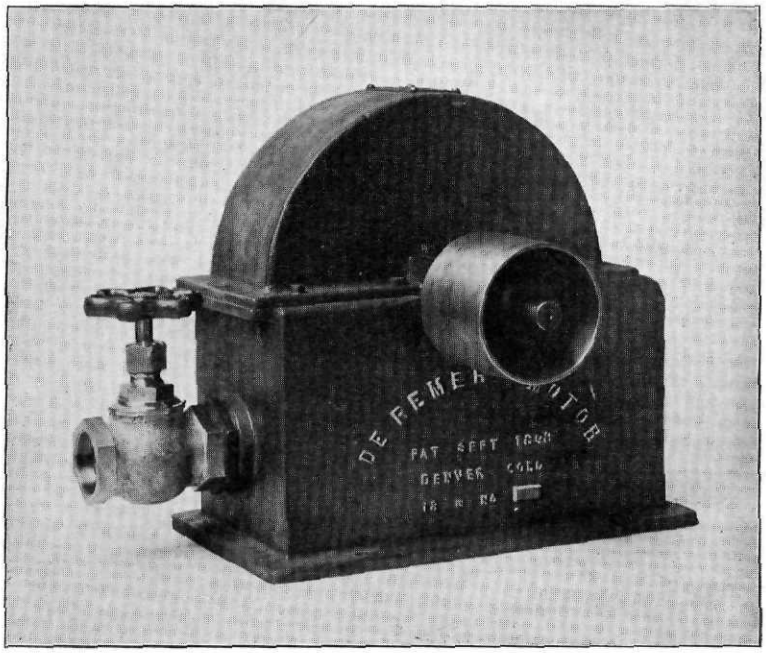
Second—A portion of the water impacts at the base of the horizontal splitters forming a water wedge or "splitter;" the dividing stream is taken up by the concave sides of the bucket, causing a continuous solid blow until the stream is cut off by the succeeding bucket.

Third—The dead water is discharged, in part, by gravity and centrifugal force. No dead water comes in contact with the succeeding buckets, the discharge being at sides and forward into the tailrace.

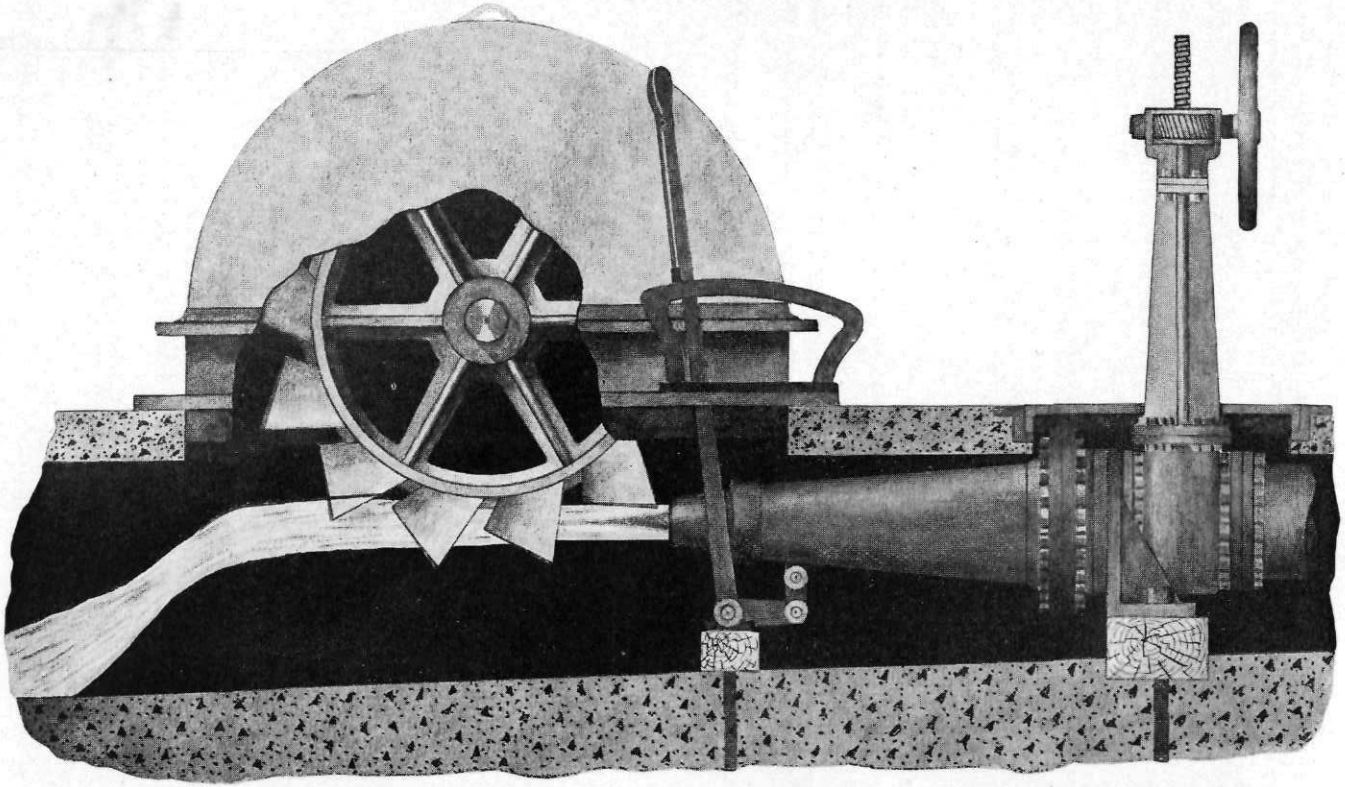
Fourth—The horizontal splitters being so arranged that when impingement takes place they cause a **continuous right-angle pull from wheel center,** resulting in the development of a maximum energy.

Fifth—The loss in this bucket by a stream being reduced to 25% of bucket capacity is less than 1%. The same proportionate efficiency is developed by full, half, or quarter gate.

Sixth—In case of alternating heavy and light load, the DeRemer maintains a more uniform speed, and follows the most delicate action of a governor.



18-inch Cased Motor.



Style "B," Suitable for Mounting on Concrete or Masonry Foundation—for Direct or Belted Connection.—We Recommend this Design as the Most Rigid, Durable, Economic and Applicable to Meet All Power Conditions.

PREFACE

POWER is the priceless gift of the Creator, and furnishes inventive man golden opportunities of progress. Abundant, cheap power is the foundation of the success of any industrial enterprise. The discovery of the power of steam was a great impetus to all lines of industry, and the many inventions since of devices calculated to utilize and develop that power have placed American machinery ahead of that of every other nation.

The next stage of evolution was the invention of devices for the utilization of the vast irresistible force contained in the water courses of the country. At first this was done as a medium of economizing of power and found its expression in the old-fashioned gravity water wheels, "overshot" and "undershot," which crude devices secured but a tithe of the energy of a given amount of water in a stated time and were often impracticable because requiring so large a volume of water. Then another step was taken when the turbine was invented, utilizing large streams under low heads. Then came the tangential impulse wheels requiring small streams under high heads. These devices soon brought hydraulic power into favor, as greater efficiency was developed with these smaller volumes of water skillfully applied.

When electrical energy began less than a score of years ago to command attention as the coming cheap power, the application of hydraulic force to create this new and rapid agent of modern industry at once centered attention upon the most effective devices for that purpose. This presented one of the most interesting economic problems that scientists have yet been called upon to consider.

The harnessing of such magnificent streams as Niagara, making possible the transmission of electric energy, in some instances hundreds of miles, demonstrates the rapid progress in the development of electro-hydraulic devices for utilizing power.

Without going into dry detail it may be said that absolutely no form of power has yet been discovered so uniform, efficient and economical as that inherent in water. Going a step further, it is also true that no device has yet been invented that can so cheaply, conveniently and effectively utilize that power as the **DeRemer Tangential** Water Wheel.

A careful consideration of users of power is invited to the following brief statement of facts:

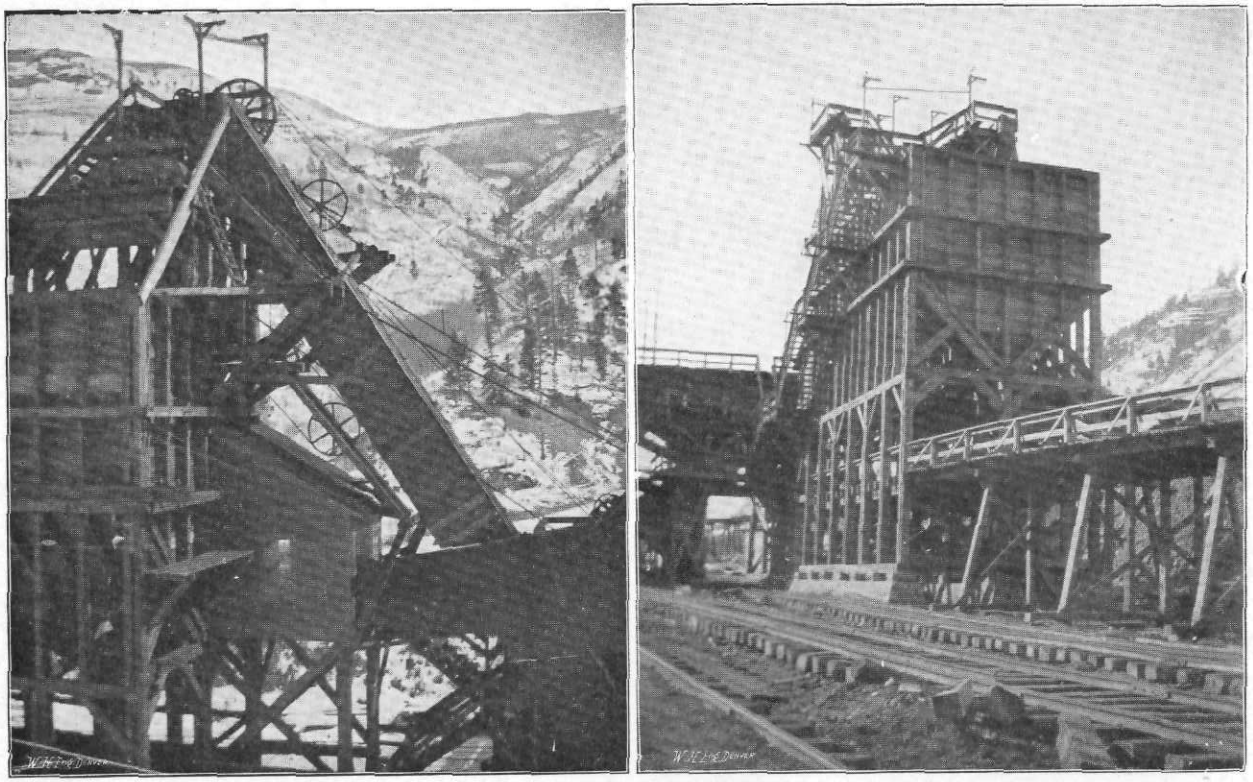
The DeRemer Water Wheel

Is not of the "tangential impulse" type, but a step in advance of that well known make. **The DeRemer** is of the type properly described as a

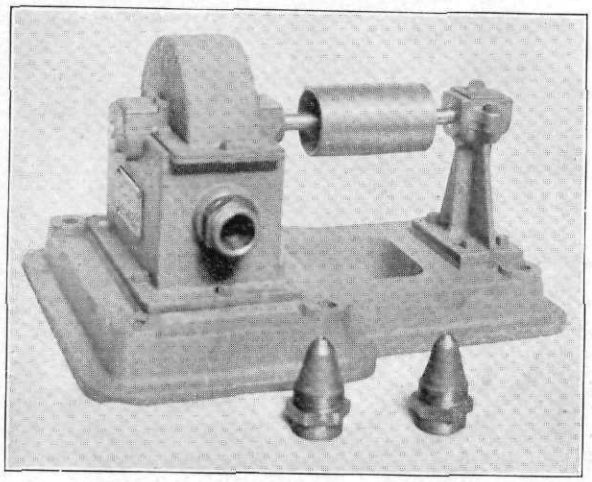
Tangential Impact

Representing a new feature in hydraulic water power, and has a guaranteed 10 per cent. higher efficiency than any other water wheel. Under carefully conducted scientific tests by the best practical hydraulic engineers in the United States the DeRemer wheel has developed 90 per cent. efficiency. This high standard is maintained under heads ranging from 200 to 2,000 feet. This range of capacity covers the entire field.

Under various carefully arranged scientific tests, as well as under the widely varying conditions met with in practical use, the DeRemer water wheel has demonstrated its superiority over all other water wheels, and is entitled to first place. The numerous and different types of water wheels, tangential and turbines, displaced by the DeRemer as shown by references and testimonials in this catalog, should be proof positive to the most skeptical of the justice of the claims made.

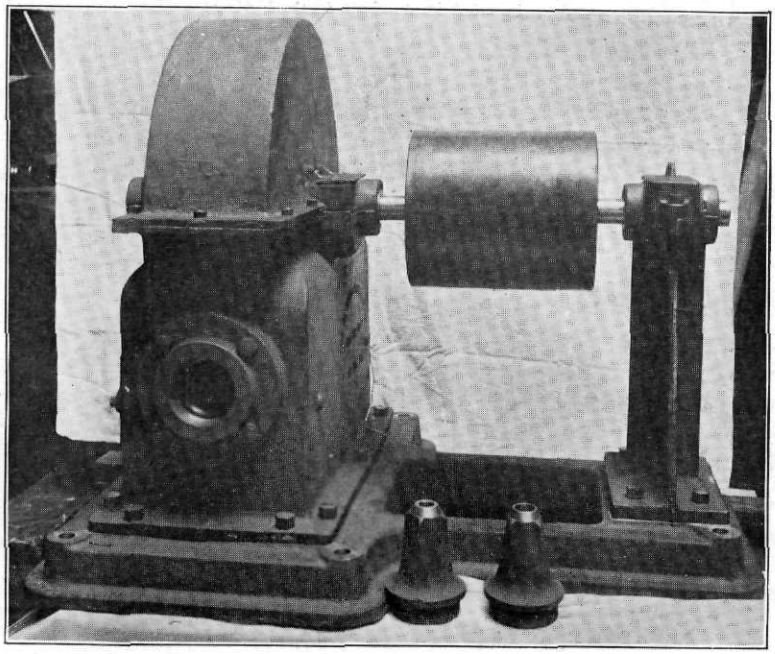


The above illustrations are from photos. of coal chutes and tipple of The Colorado Fuel & Iron Co., Redstone, Colorado, *operated by a three-foot* DeRemer Water Wheel. The operating of coal chutes and tipples at the MOUTH OF A COAL MINE by water wheels suggests economy through the application of the DeRemer system of power.

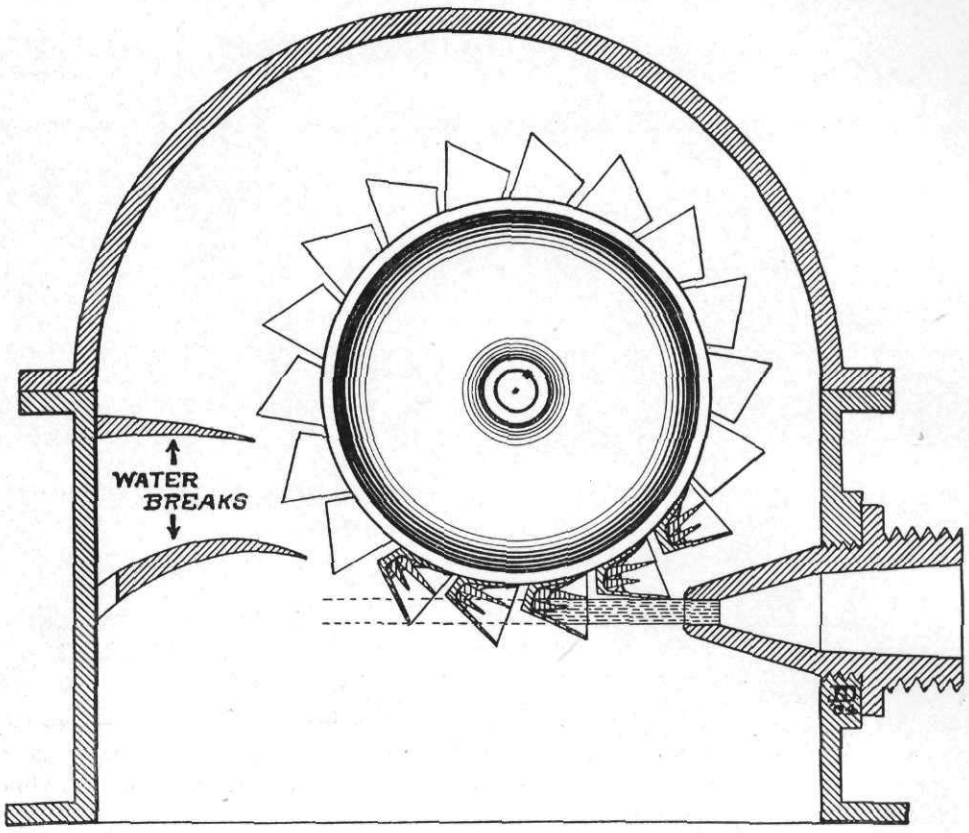


6-in. DeRemer Motor—Sub-Base.

The 6-inch and 18-inch Special Bronze, Sub-Base, Outboard-Bearing Motors shown on this page were sold to the J. George Leyner Machinery Co., Denver, Colorado. These wheels work under an effective head of seven hundred and twenty (720) feet. **The 6-inch motor operates an eleven horse power blower and the 18-inch operates an eighty horse power air compressor.**



18-in. DeRemer Motor—Sub-Base.



Sectional View of 12-inch Motor.

The Water Breaks

The "Water Breaks," as shown in sectional view of a 12-inch Motor, were first introduced by Mr. DeRemer in the wheel case to take up and deflect the discharging water and prevent its again coming in contact with the water wheel as a retarding element. All of our cased motors contain fixed water breaks; the larger, those termed power wheels, when sent out for installation will be accompanied with blueprints showing the position of the water breaks and we ask that the purchasers, for their own protection as well as ours, see to it that the Engineer making the installation does not *overlook the water breaks. Under the DeRemer system of water power the discharge of* the water after performing its function of transmitting all of its inertia to the water wheel, is made from both sides and forward or straight-away on parallel line with the inlet; in the absence of the water breaks the discharging water is dashed against the end wall of wheel pit and glances back onto the water wheel, producing a retarding influence. This difficulty we have met with in practice, more especially in cases where we have equipped other makes of water wheels with DeRemer buckets; in such cases we have discovered that with wheels of 36-inches and under, using large nozzles, the wheel pit is invariably too small. With 4-foot, 5-foot, 6-foot and larger wheels of other makes, we met with no difficulty in introducing DeRemer buckets and raising the efficiency materially.

Standard Wheels

The term "standard" applies to Motors varying in size from six to twenty-four inches and inclosed in Cast Iron Cases, and Power Wheels to be mounted on Wood or Channel Steel Frames, and are specifically designated in the price lists. These wheels have a Large Horse Power Capacity and will satisfy general power requirements. We build Special Wheels for special conditions, for which prices will be quoted on application.

Cased Motors

These wheels vary in size from 6 inches to 24 inches and are self-contained or inclosed in Cast Iron Housings; they embrace the same design and perfect construction and develop the same high efficiency as the larger wheels.

The wheel and buckets of the 6-inch and 12-inch motors are cast in one piece, in dry sand cores, and are models of mechanical skill. The bearings are of phosphor bronze, non-friction metal, ring-oiling and require the least possible attention. Three interchangeable nozzle tips furnished with each wheel; these admit of a wide variation both as to power and speed.

Installation of Motors

1. See to it that the supply pipe is of sufficient dimensions to insure maximum pressure. If necessary for adequate water supply put two taps into the "main" and unite the pipes a short distance therefrom.

2. The discharge pipe must be of ample capacity to dispose of the waste water.

3. The speed for highest efficiency should be that indicated in the "Power Tables" under the respective pressures. This applies to "running pressure," that indicated on the water gauge with valve wide-open.

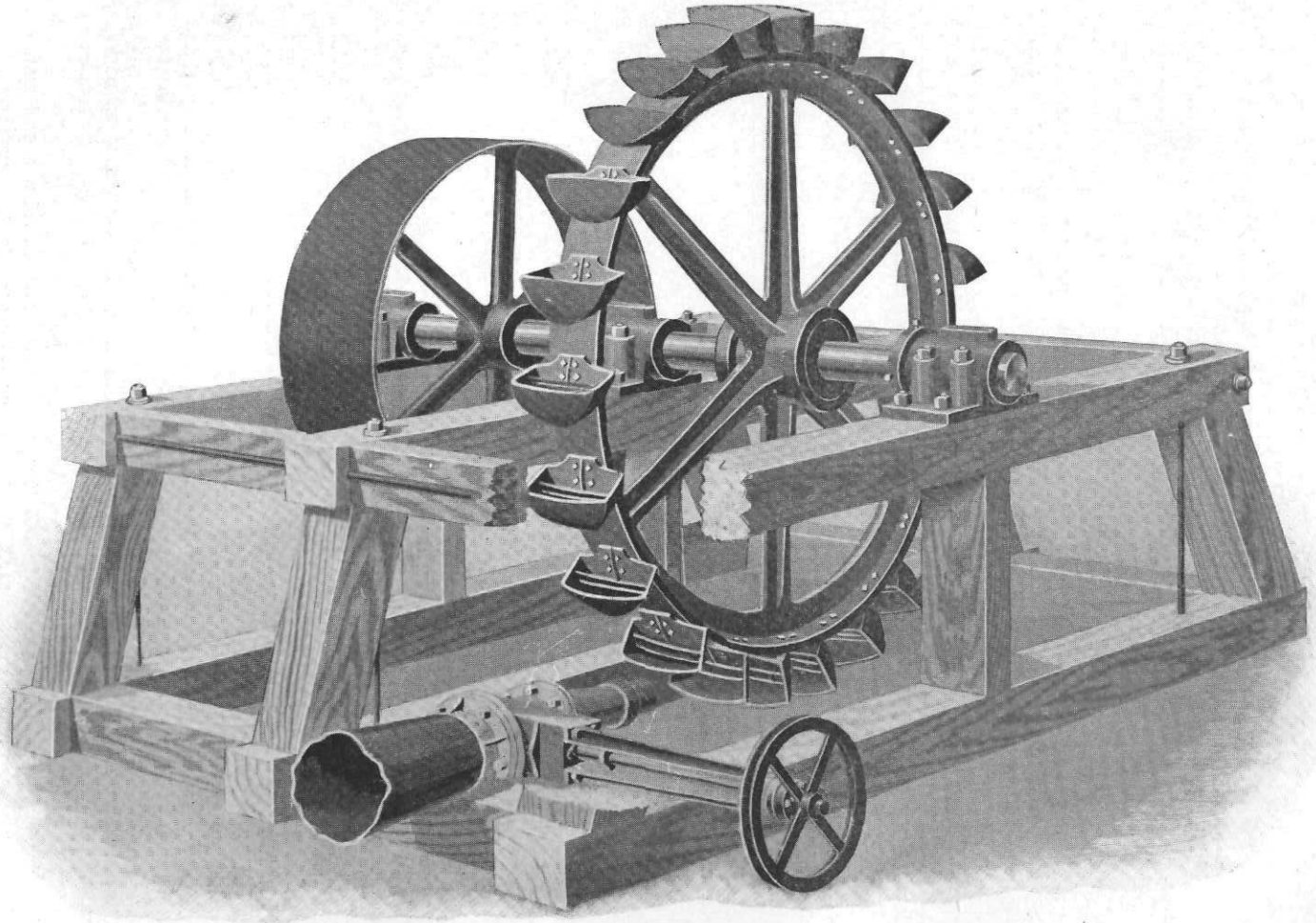
Cast Iron Bases for motors with which to connect to discharge pipe will be charged extra.

Methods of Wheel Mounting

For most mining purposes wheels are generally mounted on timber frame work, as illustrated on page 14. In most cases it is more economical to build the frame work and housing on the ground than to pay freight on the material from our shops. Most any millwright or carpenter, or anyone reasonably familiar with wood working, can construct the frame work from detailed drawings furnished the customer by us. If suitable material is not at hand, and it is so desired, we will furnish all necessary frame work, anchor and tie bolts—in which case the wheel is mounted on the frame work in our shops, all pieces marked, taken down and packed for shipment. In this way the outfit can be readily assembled on the ground.

For heavier duty it becomes necessary to mount the wheel more rigidly than can be accomplished with a wood frame. Under these circumstances we advise the use of either channel steel frame, such as is shown on page 18, or our Style "C" and "B" cast base plate, mounted on concrete foundation as shown by illustration on pages 2 and 8. While these last named outfits are somewhat more expensive they are more to be preferred on account of their durability, rigidity and economy.

For high class hydro-electric installations, such as municipal, railway and manufacturing plants, we recommend our three-quarter or fully cased outfits, as shown on pages 7 and 8. These represent the highest class of water wheel installation, and while representing the highest class of workmanship and mechanical skill, are built on lines to conform with the general outline and appearance of the secondary apparatus.



Six-Foot DeRemer Water Wheel, wood frame, installed at Silverton, Colorado, for the Kendrick & Gelder Smelter. Style "D."

Turbines vs. Tangential Wheels

DeRemer wheels have been tested under heads as low as 12 feet, and it has been found that the same high efficiency can be obtained under low heads as under extremely high and intermediate heads. The great disadvantage for the tangential wheel under low heads is the fact that the first cost is generally prohibitive for a comparatively large power output.

When it is possible to obtain perfectly clean water, free from sand and grit, turbines are ordinarily reliable, while under very low heads they are undisputably the only form of wheel that can be used advantageously. But in cases where there is grit present, it is a well-known fact that the life of a turbine is short. The runner and guide buckets are soon cut out and the efficiency materially reduced.

We, therefore, do not recommend tangential wheels for heads less than 45 to 50 feet, except in cases where but a few horsepower are required. For heads of 50 feet or over no other than the tangential wheel should be given any consideration whatever. There is no limit to high heads; all that is required is a safe and convenient method of conducting the water to the wheels.

Multiple Nozzles

In cases where the wheel must have a definite and fixed value and the power from a single jet is insufficient, multiple nozzles are introduced. These nozzles are placed in fixed positions around the periphery of the wheel and admit of greatly increased power at a small additional cost, and maintain a much higher efficiency than any form of turbine.

Our nozzle pipes are so constructed that the nozzle tips are readily interchangeable, admitting of a wide variation of power, and at the same time keeping the speed of the wheel constant. This phase of water power is most noticeable in power plants having a variable water supply throughout the year.

Construction

All bearings are non-friction, of best grade of babbitt metal, self-aligning and ring oiling—no better in the market.

The nozzle is provided with three interchangeable tips of different diameters. Select from the set the tip that will handle the maximum load. This will obviate the necessity of any further change of tips, for the reason that under the DeRemer system of water power the same proportionate amount of power is transmitted by full, half or quarter gate. That is to say, if you are using an inch tip, pulling a maximum load, the load can be reduced one-half and the speed of the wheel regulated by valve; the power developed will be proportionate to the amount of water used under the reduced head. NO OTHER WATER WHEEL ON THE MARKET EMBRACES THIS IMPORTANT FEATURE.

All Standard Motors have two journals; this is sufficient for ordinary work. For high head and heavy duty we make a Sub-based, Three Journal Motor, with Phosphor Bronze or Steel Buckets, and recommend this style for durability and economy. Price —Add 40 per cent. to catalog price of Standard Motors.

The Bucket Fastening

For wheels of six inches in diameter the buckets are cast on the rim of the wheel. For larger sizes the buckets are made detachable, to allow for replacement when damaged or broken by stones passing through the nozzle.

The base of the DeRemer bucket is cast to bed to the wheel rim and securely bolted, and in addition is provided with a cast chipping strip, which fits in recess on following bucket, thus equalizing the strain to all the buckets, instead of any particular one.

Wheels that have been running constantly for over ten years under varying conditions have not shown up a single case of a "loose bucket"—where our instructions have been complied with. However, when preferred by the purchaser, we will supply buckets to straddle the wheel rim, machined and fitted to the sides of the wheel periphery and secured by bolts extending from side to side, ream fitted.

Connections

In all cases possible we advise the use of direct connected machinery, the shaft of the water wheel being directly connected to the shaft of the secondary mover by means of our Improved Flexible Leather Link Coupling. We also use insulated dental couplings, magnetic friction clutches and rigid flange couplings. With our flexible coupling it is possible to connect two shafts not in perfect alignment.

By thus directly connecting two shafts it dispenses with large, expensive and power-consuming belts—a source of continual trouble and annoyance, and, in addition, a great saving in first cost, as well as economy in floor space and operation.

High Heads and Their Advantages

The principle upon which the DeRemer water wheel operates makes high heads particularly desirable. The amount of water for a given amount of power decreases directly as the head increases, thus the first cost is often reduced by obtaining a higher head and reducing the size and thickness of the pipe line.

Another advantage of a high head is that a higher speed for a given wheel can be obtained, and in cases of direct connection lower priced machinery can be used.

Regulation

We advise, especially in cases where governor regulation is required, the exclusive use of Ball Joint Deflecting Nozzle Pipes, more especially so under high heads. A pipe line, to give good results, must be protected from water hammer. Any device, such as needle or plug nozzle, increases the chances for water hammer and decreases the successful operation of a power plant, from the fact that these devices are more likely to become suddenly clogged with small roots, sticks and pebbles, which it is next to impossible to keep screened from the water. On the other hand, with a deflecting nozzle no more chances are taken than with the ordinary nozzle.

Where it is impossible or not convenient to use the deflecting nozzle, we introduce cut-off hoods, which are merely steel plates rigidly connected to the nozzle pipe, and capable of being swung upward into the stream, thereby deflecting a portion of the water into the tail race.

Both the hoods and deflecting nozzles are operated and controlled by means of suitable throw arms and rock shafts.

The Pipe Line

The actual head of a fine water power proposition is too frequently **"slaughtered"** by the lack of hydraulic knowledge of the designer of the plant. The effective head or pressure that can be delivered to the water wheel depends on the proper design and construction of the pipe line. By choosing the proper diameters of the pipe in ratio to its length, and avoiding unnecessary and abrupt crooks and bends, the frictional loss may be controlled to the minimum.

The kind of pipe varies as do the conditions under which it is to work. Sheet steel spiral riveted pipe is extensively used, and gives excellent satisfaction when properly installed and protected. The maximum head under which spiral riveted pipe can be used depends a great deal upon the diameter required.

Wood pipe, either continuous or coupled, also gives good satisfaction, and under certain conditions has greater life than iron or steel pipe. It is also a very much less expensive conduit to install. One great advantage of the wood pipe is that it can be bent to conform to the contour of the ground more closely than iron or steel pipe.

Laying the Pipe Line

When practicable it is advisable to lay the pipe in a trench, covering it with earth. In warm climates this is not necessary as a protection against frost, but to prevent expansion and contraction by variation of temperature, and affords security against accident. When laid over a rocky surface, a covering of straw or manure will protect it from the sun, and generally from freezing, as water in motion under pressure owing to friction, will withstand a great deal of cold weather without causing trouble. Pipe line should be tested before covering to see if joints are tight.

The pipe line must be laid so that the intake will be higher than any intermediate point between that and the water wheels. In a number of cases we have been called on to examine plants, installed by others, that were not delivering the required or normal horse power. In one case the plant, as a whole, was delivering 38 per cent. efficiency. The pipe line was 46 inches in diameter throughout and 22,000 feet long. In laying the pipe the contour of the formation was followed; with the result that at NINE points between the intake and water wheels the line was laid on a reverse grade, thus causing air pockets. Under the conditions the running pressure was 70 pounds, and after changing the line to the proper grade the pressure was raised to 116 pounds. Cost of changing the pipe line, $11,000. Convincing evidence of the importance of correct installation.

Horse Power in Water

Work is the overcoming of resistance continually occurring along the path of motion, and is expressed relatively to a unit of weight lifted through a unit of height, as one pound lifted one foot in height is called one foot pound.

Power is expressed in units of work done in a unit of time, as one pound lifted one foot in one minute is called one foot pound per minute. A Horse Power is a conventional term given to the lifting of 33,000 pounds one foot in one minute.

One pound of water falling one foot in one minute does work equal to the work expended in lifting one pound one foot in one minute. From the above facts the following formula is derived:

$$\text{Horse Power (abbreviated H. P.)} = \frac{\text{cu. ft. per min.} \times \text{fall in feet} \times 62.4}{33{,}000}$$

$$\text{or H. P.} = .001894 \times \text{cu. ft. per min.} \times \text{fall in feet.}$$

When the effective head or fall is given then the cubic feet per minute required to develop the desired horse power will be:

$$\text{cu. ft. per min.} = \frac{\text{horse power desired}}{.001894 \times \text{effective head}}$$

Transposing for the effective head required,

$$\text{effective head} = \frac{\text{horse power desired}}{.001894 \times \text{cu. ft. per min.}}$$

Laying the Pipe Line

When practicable it is advisable to lay the pipe in a trench, covering it with earth. *In warm climates this is not necessary as a protection against frost, but to prevent* expansion and contraction by variation of temperature, and affords security against accident. When laid over a rocky surface, a covering of straw or manure will protect it from the sun, and generally from freezing, **as water in motion under pressure owing to friction, will withstand a great deal of cold weather without causing trouble.** Pipe line should be tested before covering to see if joints are tight.

The pipe line must be laid so that the intake will be higher than any intermediate point between that and the water wheels. In a number of cases we have been called on to examine plants, installed by others, that were not delivering the required or normal horse power. In one case the plant, as a whole, was delivering 38 per cent. efficiency. The pipe line was 46 inches in diameter throughout and 22,000 feet long. In laying the pipe the contour of the formation was followed; with the result that at NINE points between the intake and water wheels the line was laid on a reverse grade, thus causing air pockets. Under the conditions the running pressure was 70 pounds, and after changing the line to the proper grade the pressure was raised to 116 pounds. Cost of changing the pipe line, $11,000. Convincing evidence of the importance of correct installation.

Horse Power in Water

Work is the overcoming of resistance continually occurring along the path of motion, and is expressed relatively to a unit of weight lifted through a unit of height, as one pound lifted one foot in height is called one foot pound.

Power is expressed in units of work done in a unit of time, as one pound lifted one foot in one minute is called one foot pound per minute. A Horse Power is a *conventional term given to the lifting of 33,000 pounds one foot in one minute.*

One pound of water falling one foot in one minute does work equal to the work expended in lifting one pound one foot in one minute. From the above facts the following formula is derived:

$$\text{Horse Power (abbreviated } H.\ P.) = \frac{\text{cu. ft. per min.} \times \text{fall in feet} \times 62.4}{33{,}000}$$

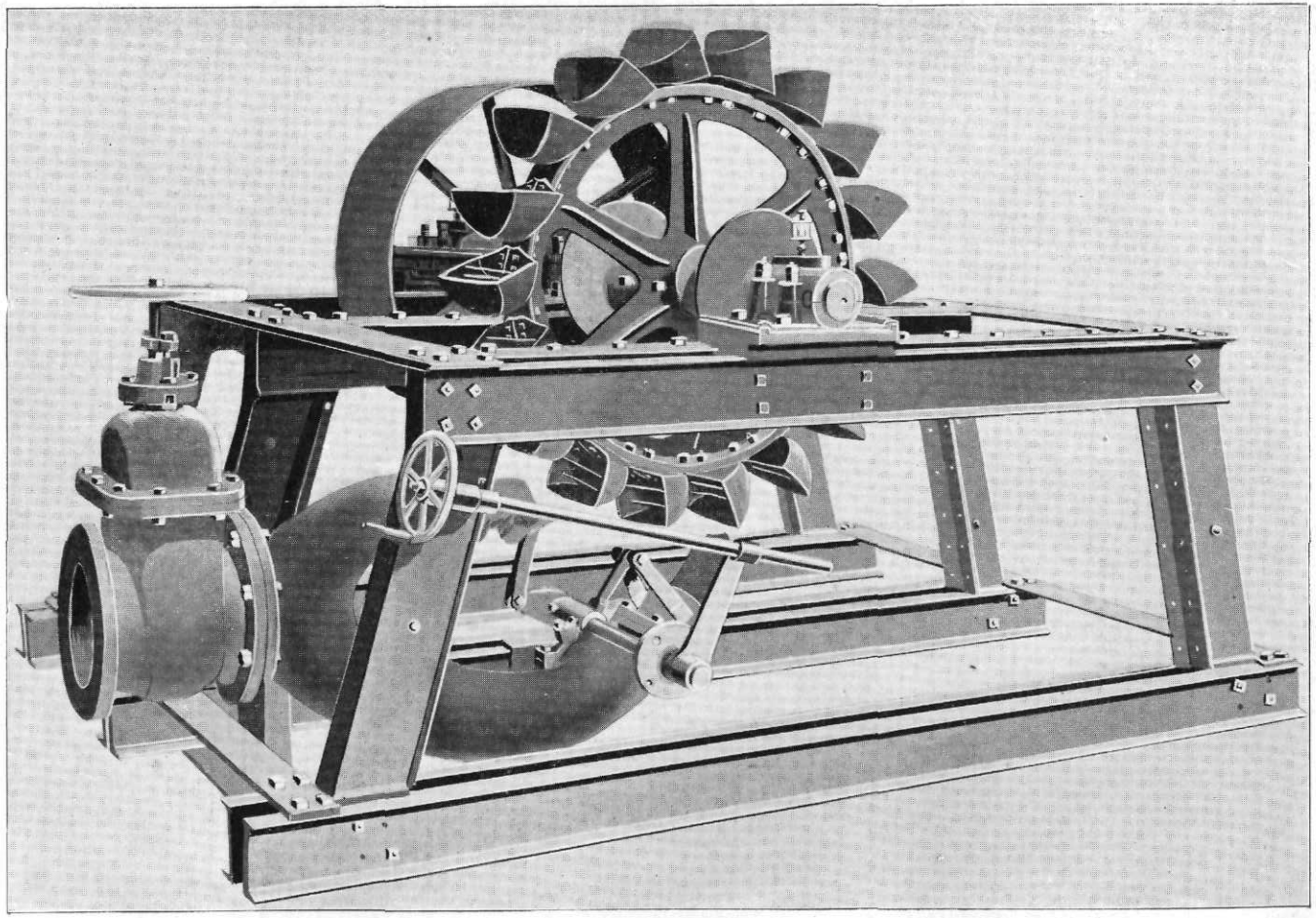
$$\text{or } H.\ P. = .001894 \times \text{cu. ft. per min.} \times \text{fall in feet.}$$

When the effective head or fall is given then the cubic feet per minute required to develop the desired horse power will be:

$$\text{cu. ft. per min.} = \frac{\text{horse power desired}}{.001894 \times \textit{effective head}}$$

Transposing for the effective head required,

$$\text{effective head} = \frac{\text{horse power desired}}{.001894 \times \text{cu. ft. per min.}}$$



Four-Foot DeRemer Water Wheel—Channel Steel Frame—Installed for the Plateau Valley Roller Mills, Snipes, Colorado—Displaced a Perfection Turbine. Style "D."

Water Supply for Power Purposes

It frequently happens, in large as well as small power plants, that the water supply is limited. Consequently when this condition is at hand, and to the operators of the plant every fractional part of a horse power means money, all of the available water must be used as economically as possible. When using water in this manner the loss of head due to friction in the pipe should not exceed 3 per cent., not including inlet and velocity head, which seldom exceeds one foot, for pipe of any diameter.

Pipe lines designed for power purposes and those designed simply for supply purposes differ widely. Pipe lines layed for power purposes should be so constructed, and of such proportions as to maintain the normal head within 3 per cent. of the total head while flowing the required amount of water.

To illustrate the difference between simply delivering a given amount of water at a given point, and delivering the same amount of water at the given point under a predetermined head, we will take as an example, 15 cubic feet of water per second under a total head of 300 feet. What size pipe will be required, the line to be 600 feet long, to deliver this amount of water at the given point under an effective head of 290 feet?

Use the formula, $d=.23034\sqrt[5]{\frac{1\ q^2}{m}}$

in which, d=diameter of pipe in feet,
l=length of pipe in feet,
q=quantity of water in cu. ft. per second,
m=loss of head in feet,

and substitute therein their respective values given in the example, and we have,

$$d=.23034\sqrt[5]{\frac{600\times15^2}{10}}$$

from which d=1.53 feet, or about a 19-inch pipe. The above quantity of water could have been delivered at the given point through a 10-inch pipe flowing full open, but the total head would have been reduced to zero.

Maximum Work

Suppose your pipe line is constructed and you can utilize all of the power available; you desire to know how much water to use on your water wheel to obtain the maximum amount of work out of your water.

When the pipe line is flowing full open, there is no other pressure than that produced by the vertical depth of water over the particular section in question. The pressure increases from 0 at full flow to full pressure (that pressure corresponding to the total head), at no flow.

The question is, where do these points meet? In other words, where do the points of decrease of flow and increase of pressure, or head, coincide? This point has, from numerous experiments, been found to be located at a point two-thirds the height of the total head; that is, the flow must be that quantity which will cut the hydrostatic pressure down one-third.

As an example, let us assume that we have a 12-inch pipe line 600 feet in length, with a total head of 100 feet. What is the maximum theoretical horse power obtainable?

Take the formula previously given, transpose, and solve for q:

$$q=39.27\sqrt{\frac{m\ d^5}{l}}$$

Substituting, we get q:

$$q=39.27\sqrt{\frac{33\times1^5}{600}}$$

from which q=9.21 cu. ft. per sec. or 552.6 cu. ft. per minute. This amount of water under an effective head of 67 feet (100-33), equals .001894×67×552.6=70.1 Theo. H. P.

NOTE.—The above formula is based upon a mean co-efficient of resistance (c in terms of the diameter in feet), and is therefore not adaptable to all conditions. It will, however, come very close in a majority of cases.

Hydraulic Sluice Mining

While Hydraulic Mining is not, strictly speaking, allied to Hydraulic Water Power, yet, inasmuch as we are frequently called upon to solve problems on these lines, we submit the following, which will be found easy of solution, correct and valuable, having been taken from actual working conditions:

Approximate Quantity of Water Required for Hydraulic Mining.—Hydraulic mining, properly, comprises all classes of mining in which the metallic substance sought is separated from its earthy mass or matrix by means of water. The term, however, is, for the most part, restricted to that class of mining in which a stream of water is projected under great pressure from a nozzle against a deep gravel deposit or earthy formation for the purpose of disintegrating the mass, thence freeing the gold and carrying off the debris. The relation of the quantity of water employed to that of material removed varies in different mines.

The duty of a miner's inch (1½ cubic feet) of water involves in its meaning the work of disintegration; but as the working head is variable from 50 to 500 or more feet, the phrase seems to refer chiefly to that portion of **work performed by the water in carrying off the debris in a sluice, the grade of which is usually 3 inches per 6 feet.** Experience shows that the duty of a 24-hour miner's inch, under a 7-inch head, equivalent to 2,230 cubic feet flow in twenty-four hours. The results in the lower workings of some mines were as follows:

North Bloomfield Mine	3.5 cubic yards
Milton Mine	2.4 cubic yards
Excelsior Mine	2.0 cubic yards
Gold Run Mine	3.5 cubic yards

while in the upper portion of the same mines the duty was much greater, say 5 to 10 cubic yards.

At the Gold Run Mine, California, for six years to November 1, 1881, 4,389,791 cubic yards were worked with 1,124,367 miner's inches of water; hence the duty per inch was 3.9 cubic yards.

Our research and observation lead us to the conclusion that four (4) cubic yards of ordinary earth or gravel is a conservative estimate to be broken down and sluiced to each 24-hour day miner's inch of water.

A "Giant" working under an extremely high head will displace more earth or gravel than one working under a lower head, but as the capacity of a plant under ordinary conditions is limited to the carrying power of the sluice, reference to our table of weir measurement will give you the information sought.

Important Notice to Agents and Purchasers

The prices named in the following tables are net, and apply only to Standard Power Wheels and Cased Motors. A Standard Outfit consists of Wheel, Shaft, Plain

Journal Boxes—Babbited; Set Collars, Gate Valve, Standard Nozzle Pipe with three interchangeable Tips for variation of Power.

Deflecting Nozzles, Cut-Off Hoods, and Ring-Oiling Journal Boxes are Extra; Prices will be given on application. Driving Pulley, Sheave Wheels or Bevel Gear Drive for water wheel shaft are not included, but will be designed and furnished at reasonable prices. Also Framework, Rods and Bolts are not included, but furnished when required, at reasonable prices.

Blueprints will be furnished free for the proper construction of the Framework and Housing—showing the location of the "Water Breaks" that are absolutely necessary to take care of the discharging water and protect the High Efficiency of the DeRemer Water Wheel.

All wheels requiring Channel Steel Frame and Sheet Steel Housing, or Cast Iron Baseplate with either Cast Iron or Sheet Steel Housing are termed "SPECIAL," and prices will be given on application.

Under No Circumstances Will This Company Sell a Water Wheel and Allow the Purchaser to Go Into the Open Market and Purchase the Balance of an Outfit. Under the DeRemer System of Water Power, in Order to Maintain the High Efficiency Established by the DeRemer Water Wheel, the Housing Containing the DeRemer "Water Breaks" Must be of Proper Design and Capacity.

Agents Deviating From This Rule Will Be Held Strictly Responsible.

The prices given in these tables were made to correspond with those of other styles of first-class water wheels. In their construction material sufficient only to withstand, with a small factor of safety, the horse power named under the conditions, and included only the old style of plain journal boxes.

We manufacture what we term the "Improved Standard." These wheels will *stand up under an effective head of 200 feet, and an Outfit consists of following:* Wheel, Shaft, Ball and Socket Ring-Oiling Journal Boxes, Set Collars, Gate Valve, Cast Iron Nozzle Pipe with three interchangeable Tips for the variation of power.

Compare the prices and weights of the Standard wheels with our "Improved Standard," which are as follows:

3-Foot Single Nozzle, 1200 to 1400 pounds	$ 400.00
4-Foot Single Nozzle, 1500 to 2000 pounds	500.00
5-Foot Single Nozzle, 2000 to 2500 pounds	600.00
6-Foot Single Nozzle, 4000 to 5500 pounds	700.00
3-Foot Double Nozzle, 1300 to 1700 pounds	625.00
4-Foot Double Nozzle, 1600 to 2400 pounds	750.00
5-Foot Double Nozzle, 3000 to 4200 pounds	900.00
6-Foot Double Nozzle, 5000 to 6500 pounds	1,000.00

The following are the weights of our Cased Motors:

6-in.	40 lbs.—With Sub-base and Outboard Bearing (3 journals)	60 lbs.
12-in.	120 lbs.—With Sub-base and Outboard Bearing (3 journals)	155 lbs.
18-in.	325 lbs.—With Sub-base and Outboard Bearing (3 journals)	410 lbs.
24-in.	850 lbs.—With Sub-base and Outboard Bearing (3 journals)	1000 lbs.

For price on three journal motors, including cast baseplate and standard, add 40 per cent. to list price of standard motors.

Quotations subject to change without notice. All agreements are contingent upon strikes, accidents and other delays unavoidable or beyond our control.

In the absence of a written contract, all Agents will confine their quotations to Catalogue prices.

Owing to the variable conditions met with in practice a standard pulley, bevel gear or sheave wheel drive can not be arranged; it is understood, however, that the DeRemer Water Wheel Co. will, in all cases, design and supply these articles, at reasonable prices.

Unless otherwise specified and agreed to, terms to customers will be cash in current funds—one-third with order, balance when ready to ship, either by remittance or sight draft, with bill of lading attached, through nearest bank, unless credit has been fully established.

We will in all cases ship goods in good condition, but will not be responsible for either prompt or safe delivery. This Company will co-operate with customers in having claims equitably adjusted.

State whether you desire shipment by freight or express and your preference in route.

The 3 and 4-foot wheels come within the limit of mule packing. Larger sizes can be sectionalized to 250 or 300 pounds. Prices of special sectionalized wheels upon application.

Submit to us the necessary data for any water power proposition, and we will be pleased to furnish preliminary plans free of charge. Construction plans in detail are furnished with all work sent out.

We have made water power an exclusive study for many years. We designed, manufactured and installed many of the largest water power plants in the United States, with unvarying success. These facts should be an assurance that all information of water powers will be absolutely reliable.

All work will be adapted to the requirements, involving all the elements of security, reliability and economy.

With a correct data, as to vertical head and quantity of water, there can be no disappointments in the results.

We supply, at reasonable rates, all material in connection with a complete water power installation.

Important Notice

The speed and power of the DeRemer water wheels as given in the following power tables were, as far as practicable, made from actual performance under practical working conditions. The speed as recorded is faster than that of any other tangential water wheel in the market. Such other wheels are required to run at an exact speed in order to develop maximum efficiency. The DeRemer has a broader range and admits of 10 per cent. deviation from this rule. The power tables show maximum speed. Example: Power Table records a speed of 1,000 revolutions per minute; the connection, be it belted or direct to dynamo, can be made for a speed of 900 R. P. M. and practically the same power will be developed up to the 1,000 point. This feature will admit of a 10 per cent. overload in a Generator.

In view of the above facts Agents and Power Users are requested to arrange their connections, be they direct to generator or belted, at 90 per cent. of the Catalogue Speed; this will give a factor of safety of 10 per cent.

PRICE LIST

OF STANDARD DE REMER WATER WHEELS AND MOTORS. Motors are enclosed in cast iron cases. The Single and Double Nozzle Wheels as listed are for mounting on timber, or channel iron frame-work. These wheels are also enclosed in iron cases when desired. Prices quoted on application. For special wheels, where standard wheels will not meet the requirements, prices will be furnished on application.

STANDARD MOTORS.

HEAD IN FEET	6 INCH WHEEL		12 INCH WHEEL No. 1		12 INCH WHEEL No. 2		18 INCH WHEEL		24 INCH WHEEL	
	H. P.	PRICE	H. P.	PRICE	H. P.	PRICE	H. P.	PRICE	H. P.	PRICE
20	.06	$ 30.00	.13	$ 60.00	17	$ 70.00	.39	$175.00	.70	$275.00
50	.22	30.00	.61	60.00	69	70.00	1.56	175.00	2.78	275.00
80	45	30.00	1.05	60.00	1.42	70.00	3.25	175.00	5.62	275.00
100	.63	30.00	1.47	60.00	1.67	70.00	4.42	175.00	7.86	275.00
150	1.15	35.00	2.71	70.00	3.62	80.00	8.13	175.00	14.45	275 00
200	1.78	35.00	4.16	70.00	5.57	80.00	12.54	175.00	22.26	275.00
250	2.50	35.00	5.84	70.00	7.78	80.00	17.51	175.00	31.11	275.00
300	3.28	40.00	7.67	80.00	10.25	90.00	23.02	200.00	40.89	300.00
350	4.13	40.00	9.67	80.00	12.91	90.00	29.02	200.00	51 54	300.00
400	5.06	40.00	11.81	80.00	15.78	90.00	35.45	200.00	62.97	300.00
450	6.03	50.00	14.10	90.00	18.83	100.00	42.30	220.00	75.14	330 00
500	7.07	50.00	16.51	90.00	22.05	105.00	49.56	220.00	88.02	330.00
600	9.18	60.00	25.47	110.00	27 56	115.00	65.14	230.00	115 69	330.00
700	11 60	60.00	32.10	120.00	36.54	135.00	82.08	250.00	145.80	360.00
800	14.14	70.00	39.21	120.00	44.64	140.00	100.29	275.00	178.14	390.00
900	16.87	80.00	46 80	130.00	53.27	150.00	119.67	300.00	212.57	420.00
1000	19.76	90.00	54.81	140.00	62.40	160.00	140.17	325.00	248.97	460.00

The No. 2—12-inch motor—has a sub-base and three journals, and designed for heavier work than the No. 1.

PRICE LIST, POWER AND WEIGHT

STANDARD DE REMER WATER WHEELS.

These prices are based on wheels for mounting on timber or channel-iron frames or masonry foundations and include wheel, shaft, boxes, collars, gate, nozzle and three nozzle-tips for variation of power.

HEAD IN FEET	3 FOOT WHEEL		4 FOOT WHEEL		5 FOOT WHEEL		6 FOOT WHEEL	
	H. P.	PRICE	H. P.	PRICE	H. P.	PRICE	H. P.	PRICE
10	.80	$ 220.00	1.38	$ 285.00	2.18	$ 350.00	3.13	$ 400.00
20	1.58	220.00	2.65	285.00	4.39	350.00	6.30	400.00
50	6.28	220.00	11.13	285.00	17.46	350.00	25.12	400.00
80	12.64	230.00	22.51	295.00	35.22	370.00	50.56	425.00
100	17.68	240.00	31.43	300.00	49.19	380.00	70.73	450.00
150	32.56	250.00	57.83	320.00	90.53	400.00	130.24	475.00
200	50.14	265.00	89.05	350.00	139.33	425.00	200.55	500.00
250	70.08	280.00	124.47	375.00	194.74	450 00	280.30	550.00
300	92.12	300.00	163.62	400.00	256.01	485.00	368.48	625.00
350	116.09	320.00	206.20	425.00	322.61	550.00	464.38	700.00
400	141.83	340.00	251.94	460.00	394 17	625.00	567.37	800.00
450	169.24	360.00	300.63	500.00	470.34	700.00	677.02	900.00
500	198.24	390.00	352.11	540.00	550.89	775.00	792.96	1000.00
550	234.95	425.00	417.30	600.00	652.91	.. ..	939.79	.. ..
600	260.56	450.00	462.81	675.00	724.11	.. ..	1042.28	.. ..
700	328.36	500.00	583.23	750.00	912.51	.. ..	1314.46	.. ..
800	407.19	.. ..	712.59	.. ..	1114.90	.. ..	1604.78	.. ..
900	478.74	.. ..	850.29	.. ..	1330.37	.. ..	1914.94	.. ..
1000	560.71	.. ..	995.90	.. ..	1558.16	.. ..	2242.84	.. ..
		Special		Special		Special		Special
	WEIGHT 700 to 1,000 LBS.		WEIGHT 1,000 to 1,700 LBS.		WEIGHT 1,400 to 2,100 LBS.		WEIGHT 2,100 to 5,000 LBS.	

Price List, Power and Weight

STANDARD TWO-NOZZLE DEREMER WATER WHEELS.

These prices are based on wheels for mounting on timber or channel-iron frames or masonry foundations and include wheel, shaft, boxes, collars, gate, nozzle and three nozzle-tips for variation of power.

HEAD IN FEET	3 FOOT WHEEL		4 FOOT WHEEL		5 FOOT WHEEL		6 FOOT WHEEL	
	H.P.	PRICE	H.P.	PRICE	H.P.	PRICE	H.P.	PRICE
10	1.60	$300.	2.76	$375.	4.36	$425.	6.26	$500.
20	3.15	300.	5.54	375.	8.77	425.	12.60	500.
30	5.75	300.	10.24	375.	16.15	425.	23.18	500.
40	8.90	310.	15.91	380.	24.88	435.	35.61	510.
50	12.55	325.	22.34	385.	34.92	440.	50.25	520.
60	16.45	340.	29.27	390.	45.71	450.	65.85	530.
70	20.75	360.	36.91	400.	57.77	460.	82.99	550.
80	25.28	380.	45.02	420.	70.43	475.	101.13	575.
100	35.36	400.	62.85	450.	98.38	500.	141.45	600.
150	65.12	440.	115.66	500.	181.06	575.	260.48	700.
200	100.27	480.	178.10	575.	278.67	650.	401.10	800.
250	140.25	525.	248.93	650.	389.44	750.	521.22	900.
300	184.23	550.	327.24	680.	512.02	800.	736.97	960.
350	232.17	575.	412.39	710.	644.85	860.	928.76	1025.
400	283.66	600.	503.87	740.	788.34	925.	1134.73	1125.
450	338.49	625.	601.25	775.	940.69	1000.	1344.58	1225.
500	396.48	650.	704.21	800.	1101.78	1075.	1585.92	1350.
	WEIGHT 900 to 1300 LBS.		WEIGHT 1300 to 2200 LBS.		WEIGHT 1200 to 2700 LBS.		WEIGHT 2700 to 5500 LBS.	

Useful Information

1 cubic foot of water weighs.....62.4 lbs.
1 gallon of water weighs.....8.34 lbs.
Pressure of one atmosphere—Sea level.....14.7 lbs.

Pressure in pounds per square inch multiplied by 2.3 will give the vertical head required to produce such pressure.

A vertical head of water in feet multiplied by .434 will give the pressure in pounds per square inch.

A foot pound is one pound raised one foot high in one minute.

A horse power is 33,000 pounds raised one foot high in one minute.

To find the velocity in feet per second necessary to carry a given quantity of water in a pipe of given diameter, divide the quantity in cubic feet per second by the area of the pipe in square feet. The quotient will give the velocity.

To find the area of a required pipe, the quantity and velocity being given, divide the quantity in a stated time by the velocity in the same period; the quotient will be the required area, from which the diameter may readily be calculated.

A simple and convenient method for calculating the horse power required to elevate water, is the following:

The cubic feet per minute multiplied by the number of feet raised, and the product divided by 528.

Example.

You have 100 cubic feet of water to be raised 100 feet. 100×100 equals 10,000; this divided by 528 equals 18.9 horse power. An allowance of 25 per cent. should be made for friction.

To calculate the horse power of a specific quantity of water under a given head: Multiply the number of cubic feet per minute by the head in feet, the product by 62½, the weight of a cubic foot of water, and divide this product by 33,000 thus: 200 cubic feet by 100 feet head by 62½ equals 1,250,000, divided by 33,000 equals 37.8 horse power.

DE REMER WATER WHEEL TABLES

This table applies only to Standard De Remer Water Wheels with one nozzle. The horse power is based on effective heads and NINETY PER CENT EFFICIENCY—fully guaranteed under contract. Water required is given in cubic feet per minute and miner's inches. One miner's inch is equal to 1½ cubic feet per minute.

The small figures under "head in feet" represent the working pressure in pounds and spouting velocity of the stream in feet per minute.

Note the increased wheel velocity over the Pelton, Leffel, Hug and all other wheels of their class, THIS REPRESENTS POWER.

HEAD IN FEET	SIZE OF WHEELS	6 INCH	No. 1 12 INCH	No. 2 12 INCH	18 INCH	24 INCH	3 FOOT	4 FOOT	5 FOOT	6 FOOT
20	Horse Power	.06	.13	.17	.39	.69	1.57	2.77	4.38	6.30
	Cubic Feet.....	1.67	3.91	5.21	11.72	20.83	46.93	83.32	130.36	187.72
8 lbs.	Miner's Inches ...	1.04	2.44	3.47	7.82	13.88	31.28	55.52	86.90	125.12
2151.9	Revolutions	718	359	359	239	179	120	89	73	60
30	Horse Power	.11	.24	.32	.75	1.83	2.90	5.12	8.07	11.59
	Cubic Feet.....	2.05	4.79	6.39	14.36	25.51	57.44	102.04	159.66	229.76
13.0 lbs.	Miner's Inches ...	1.28	2.99	4.26	9.57	17.00	38.28	68.00	106.44	153.12
2635.6	Revolutions	878	438	438	292	219	145	109	87	72
40	Horse Power	.16	.37	.49	1.11	1.98	4.45	7.95	12.44	17.80
	Cubic Feet.....	2.37	5.53	7.37	16.59	29.46	66.36	107.84	184.36	265.44
17.3 lbs.	Miner's Inches ...	1.48	3.45	4.91	11.06	19.64	44.24	78.56	122.91	176.96
3043.4	Revolutions	1014	508	508	339	254	169	127	100	84
50	Horse Power	.22	.50	.69	1.56	2.78	6.28	11.13	17.46	25.12
	Cubic Feet.....	2.64	6.18	8.24	18.54	32.93	74.17	131.72	206.14	296.70
21.6 lbs.	Miner's Inches ...	1.65	3.86	5.49	12.36	21.95	49.45	87.80	137.42	197.80
3402.6	Revolutions	1137	568	568	379	283	189	141	113	95
60	Horse Power	.29	.66	.90	2.05	3.59	8.23	14.63	22.85	32.92
	Cubic Feet.....	2.90	6.77	9.05	20.31	36.08	81.25	144.32	225.80	325.00
26.0 lbs.	Miner's Inches....	1.81	4.23	6.02	13.54	24.05	54.16	96.20	150.52	216.64
3727.3	Revolutions	1244	621	621	414	310	206	155	124	103
70	Horse Power	.36	.86	1.15	2.59	4.60	10.37	18.45	28.88	41.49
	Cubic Feet	3.13	7.31	9.75	21.94	38.97	87.76	155.88	243.89	351.04
30.3 lbs.	Miner's Inches....	1.95	4.56	6.50	14.63	25.98	58.52	103.92	162.60	234.08
4026.0	Revolutions	1345	672	672	448	336	223	168	136	111
80	Horse Power	.44	1.05	1.42	3.16	5.62	13.06	22.51	35.21	50.56
	Cubic Feet.....	3.35	7.82	10 42	23.46	41.66	93.84	166.64	260.73	375.36
34.7 lbs.	Miner's Inches....	2.09	4.88	6.94	15.64	27.77	62.56	111.08	173.82	250.24
4303.9	Revolutions	1436	718	718	478	359	239	179	143	120
90	Horse Power	.52	1.26	1.67	3.78	6.70	15.12	26.86	42.04	60.48
	Cubic Feet.....	3.55	8.29	11.06	24.88	44.19	99.52	176.75	276.55	398.08
39.0 lbs.	Miner's Inches....	2.22	5.18	7.37	16.58	29.46	66.32	117.83	184.36	265.28
4565.0	Revolutions	1524	762	762	508	381	254	190	152	127
100	Horse Power	.63	1.47	1.98	4.42	7.86	17.68	31.43	49.19	70.73
	Cubic Feet.....	3.74	8.74	11.66	26.22	46.58	104.88	186.33	291.51	419.52
43 lbs.	Miner's Inches ...	2.33	5.46	7.77	17.48	31.05	69.93	124.21	194.34	279.72
4812.0	Revolutions	1605	803	803	535	401	267	200	159	133
110	Horse Power	.72	1.70	2.27	5.10	9.07	20.41	36.30	56.81	81.64
	Cubic Feet.....	3.92	9.16	12.23	27.50	48.85	110.00	195.41	305.73	440.00
48 lbs.	Miner's Inches ...	2.45	5.72	8.15	18.33	32.56	73.33	130.27	203.82	293.32
5046.8	Revolutions	1685	842	842	561	421	280	210	168	140
120	Horse Power	.83	1.93	2.60	5.81	10.34	23.28	41.38	64.74	93.19
	Cubic Feet.....	4.10	9.57	12.47	28.72	51.02	114.91	204.10	319.33	459.64
52 lbs.	Miner's Inches....	2.56	5.98	8.51	19.15	34.01	76.60	136.06	212.89	306.43
5271.3	Revolutions	1760	880	880	587	440	292	219	175	145
130	Horse Power	.93	2.18	2.92	6.56	11.66	26.27	46.68	73.00	105.08
	Cubic Feet.....	4.27	9.96	13.30	29.90	53.10	119.60	212.43	332.37	478.41
56 lbs.	Miner's Inches ...	2.66	6.22	8.86	19.93	35.40	79.73	141.62	221.58	318.94
5486.5	Revolutions	1831	916	916	611	457	305	229	182	152

DE REMER WATER WHEEL TABLES

This table applies only to Standard De Remer Water Wheels with one nozzle. The horse power is based on effective heads and NINETY PER CENT EFFICIENCY—fully guaranteed under contract. Water required is given in cubic feet per minute and miner's inches. One miner's inch is equal to 1¼ cubic feet per minute.

The small figures under "head in feet" represent the working pressure in pounds and spenting velocity of the stream in feet per minute.

Note the increased wheel velocity over the Pelton, Leffel, Hug and all other wheels of their class, THIS REPRESENTS POWER.

HEAD IN FEET	SIZE OF WHEELS	6 INCH	NO. 1 12 INCH	NO. 2 12 INCH	18 INCH	24 INCH	3 FOOT	4 FOOT	5 FOOT	6 FOOT
140	Horse Power	1.04	2.44	3.26	7.31	13.03	29.35	52.12	81.59	117.44
	Cubic Feet.....	4.43	10.34	13.80	31.03	55.11	124.12	220.44	344.92	496.48
60 lbs.	Miner's Inches ...	2.76	6.46	9.20	20.68	36.74	82.72	146.96	229.94	330.88
5693.6	Revolutions	1902	951	951	634	475	317	237	190	158
150	Horse Power	1.16	2.71	3.62	8.14	14.46	32.51	57.83	90.53	130.24
	Cubic Feet.....	4.55	10.70	14.28	32.11	57.04	128.47	228.19	357.02	513.90
65 lbs.	Miner's Inches ...	2.84	6.68	9.52	21.41	38.03	85.64	152.12	238.05	342.59
5893.4	Revolutions	1968	983	983	656	491	327	245	196	163
160	Horse Power	1.28	2.98	4.00	8.97	15.92	35.86	63.71	99.68	143.48
	Cubic Feet.....	4.73	11.05	14.75	33.17	58.92	132.68	235.68	368.73	530.75
69 lbs.	Miner's Inches ...	2.95	6.90	9.83	22.11	39.28	88.46	157.12	245.82	353.84
6086.7	Revolutions	2034	1017	1017	678	508	339	254	202	169
170	Horse Power	1.40	3.26	4.26	9.82	17.44	39.29	69.78	109.18	157.16
	Cubic Feet.....	4.88	11.39	15.20	34.19	60.73	136.77	242.93	380.08	547.08
74 lbs.	Miner's Inches ...	3.05	7.11	10.14	22.79	40.48	91.18	161.95	253.38	364.72
6274.0	Revolutions	2094	1046	1046	698	522	348	261	209	174
180	Horse Power	1.52	3.56	4.75	10.69	19.00	42.80	76.03	118.96	171.23
	Cubic Feet.....	5.02	11.72	15.65	35.18	62.49	140.74	249.97	391.10	562.96
78 lbs.	Miner's Inches....	3.13	7.32	10.43	23.45	41.66	93.82	166.64	260.73	375.29
6455.9	Revolutions	2150	1074	1074	717	538	359	268	216	178
190	Horse Power	1.65	3.86	5.16	11.60	20.61	46.41	82.46	129.01	185.70
	Cubic Feet.....	5.16	12.04	16.07	36.14	64.20	144.59	256.82	401.81	578.38
82 lbs.	Miner's Inches....	3.22	7.52	10.72	24.09	42.80	96.39	171.21	267.87	385.58
6632.8	Revolutions	2211	1105	1105	737	553	368	276	221	184
200	Horse Power	1.79	4.16	5.57	12.52	22.26	50.13	89.05	139.34	200.50
	Cubic Feet.	5.29	12.36	16.50	37.08	65.87	148.35	263.49	412.25	593.40
87 lbs.	Miner's Inches....	3.30	7.72	10.99	24.72	43.91	98.90	175.66	274.83	395.60
6805.2	Revolutions	2268	1134	1134	756	567	378	283	227	189
210	Horse Power	1.92	4.49	6.00	13.48	23.95	53.94	95.82	149.92	215.79
	Cubic Feet.....	5.42	12.66	16.90	38.00	67.50	152.01	270.00	422.44	608.03
91 lbs.	Miner's Inches....	3.38	7.91	11.26	25.33	45.00	101.34	180.00	281.62	405.37
6973.3	Revolutions	2324	1167	1162	774	580	335	290	233	193
220	Horse Power	2.05	4.82	6.43	14.46	25.68	57.84	102.74	160.75	231.38
	Cubic Feet.....	5.55	12.96	17.30	38.89	69.03	155.59	276.35	432.38	622.36
95 lbs.	Miner's Inches ...	3.46	8.10	11.53	25.93	46.05	103.72	184.23	288.25	414.91
7137.4	Revolutions	2381	1190	1190	793	595	396	297	237	198
230	Horse Power	2.20	5.15	6.88	15.45	27.45	61.83	109.83	171.84	247.34
	Cubic Feet.....	5.68	13.25	17.69	39.77	70.64	159.08	282.56	442.09	633.35
100 lbs.	Miner's Inches ...	3.55	8.28	11.79	26.51	47.09	106.06	188.38	294.73	424.24
7297.8	Revolutions	2434	1216	1216	811	609	405	304	243	202
240	Horse Power	2.35	5.49	7.33	16.47	29.26	65.90	117.07	183.17	263.65
	Cubic Feet.....	5.80	13.54	18.07	40.62	72.16	162.50	288.64	451.60	650.03
105 lbs.	Miner's Inches....	3.62	8.46	12.01	27.08	48.10	108.34	192.42	301.07	433.36
7454.7	Revolutions	2488	1244	1244	829	621	414	310	248	206
250	Horse Power	2.50	5.84	7.78	17.51	31.11	70.08	124.46	194.74	280.30
	Cubic Feet.....	5.92	13.82	18.44	41.46	73.64	165.86	294.59	460.91	663.45
103 lbs.	Miner's Inches ...	3.70	8.63	12.29	27.64	49.09	110.57	196.39	307.27	442.30
7608.4	Revolutions	2538	1269	1269	846	635	413	317	253	212

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HEAD IN FEET	SIZE OF WHEELS	6 INCH	No. 1 12 INCH	No. 2 12 INCH	18 INCH	24 INCH	3 FOOT	4 FOOT	5 FOOT	6 FOOT
260	Horse Power	2.65	6.18	8.26	18.57	33.00	74.31	132.00	206.54	297.30
	Cubic Feet.....	6.04	14.09	18.80	42.28	75.10	169.14	300.43	470.04	676.59
113 lbs.	Miner's Inches ...	3.77	8.80	12.54	28.19	50.07	112.76	200.28	313.36	451.05
7759.10	Revolutions	2589	1294	1294	863	647	431	323	259	216
270	Horse Power	2.80	6.55	8.75	19.66	34.92	78.64	139.70	218.51	314.61
	Cubic Feet.....	6.15	14.36	19.16	43.09	76.53	172.36	306.15	479.00	689.46
118 lbs.	Miner's Inches ...	3.84	8.97	12.77	28.72	51.02	114.91	204.10	319.33	459.64
7906.9	Revolutions	2639	1319	1319	879	659	440	330	263	219
280	Horse Power	2.96	6.92	9.24	20.75	36.87	83.06	147.58	230.83	332.26
	Cubic Feet.....	6.26	14.62	19.51	43.88	77.94	175.53	311.77	487.79	702.12
121 lbs.	Miner's Inches ...	3.91	9.13	13.01	29.25	51.29	117.02	205.18	325.19	468.06
8052.0	Revolutions	2690	1345	1345	896	670	448	334	267	223
290	Horse Power	3.12	7.29	9.74	21.88	38.87	87.54	155.50	243.31	350.22
	Cubic Feet.....	6.38	14.88	19.86	44.66	79.32	178.64	317.29	496.42	714.56
126 lbs.	Miner's Inches ...	3.98	9.30	13.24	29.77	52.88	119.09	211.52	330.94	476.36
8194.5	Revolutions	2737	1368	1368	912	683	455	341	273	228
300	Horse Power	3.28	7.68	10.25	23.02	40.90	92.11	163.62	256.01	368.48
	Cubic Feet.....	6.48	15.13	20.20	45.42	80.67	181.69	322.71	504.91	726.76
130 lbs.	Miner's Inches....	4.05	9.45	13.46	30.28	53.78	121.12	215.14	336.60	484.51
8334.6	Revolutions	2782	1392	1392	928	696	464	347	278	232
310	Horse Power	3.45	8.06	10.76	24.19	42.96	96.76	171.87	268.91	387.07
	Cubic Feet.....	6.59	15.39	20.53	46.17	82.01	184.69	328.04	513.25	738.78
134 lbs.	Miner's Inches....	4.11	9.61	13.69	30.78	54.67	123.12	218.69	342.17	492.51
8472.4	Revolutions	2831	1415	1415	943	707	471	353	282	235
320	Horse Power	3.62	8.45	11.31	25.36	45.05	101.48	180.26	282.03	405.95
	Cubic Feet.....	6.70	15.63	20.86	46.91	83.32	187.65	333.29	521.46	750.60
139 lbs.	Miner's Inches....	4.18	9.76	13.91	31.27	55.55	125.10	222.19	347.64	500.40
8607.9	Revolutions	2875	1437	1437	958	719	478	359	287	239
330	Horse Power	3.79	8.85	11.82	26.56	47.18	106.28	188.70	295.35	425.13
	Cubic Feet.....	6.80	15.88	21.19	47.64	84.61	190.56	338.46	529.55	762.24
143 lbs.	Miner's Inches....	4.25	9.92	14.12	31.76	56.41	127.04	225.64	353.03	508.16
8741.4	Revolutions	2920	1459	1459	973	730	486	363	290	242
340	Horse Power	3.96	9.26	12.27	27.78	49.35	111.15	197.42	308.88	444.61
	Cubic Feet.....	6.90	16.12	21.50	48.35	85.88	193.42	343.55	537.51	773.71
147 lbs.	Miner's Inches ...	4.31	10.07	14.34	32.24	57.26	128.98	229.04	358.34	515.93
8872.9	Revolutions	2963	1482	1482	988	741	493	370	296	246
350	Horse Power	4.14	9.67	12.91	29.02	51.54	116.08	206.20	322.61	464.38
	Cubic Feet.....	7.00	16.35	21.82	49.06	87.14	196.25	348.57	545.36	785.00
152 lbs.	Miner's Inches ...	4.37	10.21	14.54	32.70	58.09	130.83	232.38	363.57	523.32
9002.4	Revolutions	3008	1503	1503	1002	751	500	375	299	249
360	Horse Power	4.30	10.09	13.47	29.75	53.77	121.10	215.10	336.54	484.42
	Cubic Feet.....	7.10	16.58	22.13	49.75	88.37	199.03	353.51	553.10	796.14
156 lbs.	Miner's Inches....	4.43	10.36	14.75	33.17	58.91	132.68	235.64	368.73	530.75
9130.1	Revolutions	3052	1525	1525	1017	762	508	381	304	254
370	Horse Power	4.50	10.51	14.04	31.54	56.02	126.18	223.62	350.66	504.75
	Cubic Feet.....	7.20	16.81	22.43	50.44	89.59	201.78	358.39	560.73	807.12
160 lbs.	Miner's Inches ...	4.50	10.50	14.95	33.63	59.73	134.52	238.92	373.82	538 08
9256.0	Revolutions	3039	1546	1546	1031	772	535	386	308	257

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HEAD IN FEET	SIZE OF WHEELS	6 INCH	No. 1 12 INCH	No. 2 12 INCH	18 INCH	24 INCH	3 FOOT	4 FOOT	5 FOOT	6 FOOT
380	Horse Power	4.68	10.94	14.61	32 83	58.32	131.33	233.24	364.98	525.49
	Cubic Feet.....	7.30	17.04	22.73	51.12	90.80	204.48	363.20	568.25	817.95
165 lbs.	Miner's Inches ...	4.56	10.65	15.16	34.08	60.53	136.32	242.13	378.83	545.29
9380.3	Revolutions	3134	1566	1566	1044	783	521	391	312	260
390	Horse Power	4.87	11.37	15.19	34.14	60.64	136.55	242.55	379.48	546.21
	Cubic Feet.....	7.39	17.26	23.03	51.79	91.98	207.16	367.95	575.68	828.64
169 lbs.	Miner's Inches ...	4.61	10.78	15.35	34.53	61.32	138.11	245.28	383.79	552.43
9502.9	Revolutions	3174	1587	1587	1058	793	529	396	317	264
400	Horse Power	5.06	11.81	15.78	35.45	62.97	141.83	251.93	394.17	567.37
	Cubic Feet.....	7.49	17.48	23.33	52.45	93.16	209.80	372.64	583.02	839.20
173 lbs.	Miner's Inches ...	4.68	10.92	15.55	34.96	62.10	139.84	248.40	388.68	559.35
9624.0	Revolutions	3216	1607	1607	1072	803	535	401	321	267
410	Horse Power	5.25	12.26	16.38	36.79	65.35	147.19	261.44	409.05	588.79
	Cubic Feet.....	7.58	17.70	23.62	53.10	94.31	212.40	377.26	590.26	849.63
178 lbs.	Miner's Inches ...	4.73	11.06	15.74	35.40	62.87	141.60	251.51	393.50	566.41
9743.6	Revolutions	3257	1628	1628	1084	813	542	406	324	270
420	Horse Power	5.44	12.71	16.98	38.14	67.76	152.61	271.06	424.10	610.46
	Cubic Feet.....	7.67	17.91	23.90	53.74	95.46	214.98	381.84	597.41	859.93
182 lbs.	Miner's Inches....	4.79	11.19	15.93	35.83	63.64	143.32	254.56	398.28	573.28
9861.7	Revolutions	3298	1648	1648	1097	824	549	411	328	274
430	Horse Power	5.64	13.17	17.60	39.52	70.20	158.10	280.81	439.34	632.31
	Cubic Feet.....	7.76	18.12	24.18	54.38	96.59	217.52	386.36	604.48	870.11
186 lbs.	Miner's Inches....	4.85	11.31	16.12	36.25	64.39	145.00	257.58	402.99	580.00
9978.4	Revolutions	3335	1667	1667	1111	833	555	416	332	277
440	Horse Power	5.84	13.62	18.21	40.91	72.66	163.64	290.66	454.76	654.57
	Cubic Feet.....	7.85	18.33	24.46	55.01	97.70	220.04	390.82	611.47	880.16
191 lbs.	Miner's Inches....	4.90	11.45	16.31	36.66	65.13	146.64	260.53	407.65	586.56
10093.7	Revolutions	3373	1686	1686	1123	843	561	421	336	280
450	Horse Power	6.04	14.10	18.83	42.30	75.14	169.25	300.62	470.34	677.02
	Cubic Feet.....	7.94	18.54	24.74	55.63	98.81	222.52	395.24	618.38	890.11
195 lbs.	Miner's Inches....	4.96	11.58	16.49	37.08	65.87	148.35	263.49	412.25	593.40
10207.8	Revolutions	3378	1705	1705	1137	852	568	426	340	283
460	Horse Power	6.25	14.57	19.46	43.73	77.66	174.93	310.70	486.12	699.72
	Cubic Feet.....	8.03	18.74	25.01	56.24	99.90	224.98	399.61	625.22	899.25
200 lbs.	Miner's Inches ...	5.01	11.71	16.67	37.50	66.60	150.00	266.40	416.80	600.00
10320.6	Revolutions	3449	1724	1724	1149	862	574	430	343	286
470	Horse Power	6.44	15.04	20.10	45.16	80.22	180.66	320.89	502.05	722.66
	Cubic Feet.....	8.12	18.95	25.28	56.85	100.98	227.42	403.93	631.98	909.68
204 lbs.	Miner's Inches ...	5.07	11.84	16.85	37.90	67.32	151.61	269.28	421.32	606.44
10432.2	Revolutions	3486	1743	1743	1162	870	569	435	348	289
480	Horse Power	6.66	15.53	20.75	46.60	82.79	186.46	330.69	518.16	745.84
	Cubic Feet.....	8.20	19.15	25.55	57.45	102.05	229.82	408.20	638.66	919.29
208 lbs.	Miner's Inches....	5.12	11.96	17.03	38.30	68.00	153.20	272.12	425.78	612.80
10542.6	Revolutions	3524	1761	1761	1171	880	586	439	351	292
490	Horse Power	6.87	16.02	21.60	48.08	85.39	192.32	341.58	534.45	769.29
	Cubic Feet.....	8.29	19.35	25.82	58.05	103.10	232.20	412.43	645.28	928.83
212 lbs.	Miner's Inches ...	5.18	12.09	17.21	38.70	68.74	154.80	274.96	430.19	619 20
10551.8	Revolutions	3559	1779	1779	1186	890	593	445	355	296

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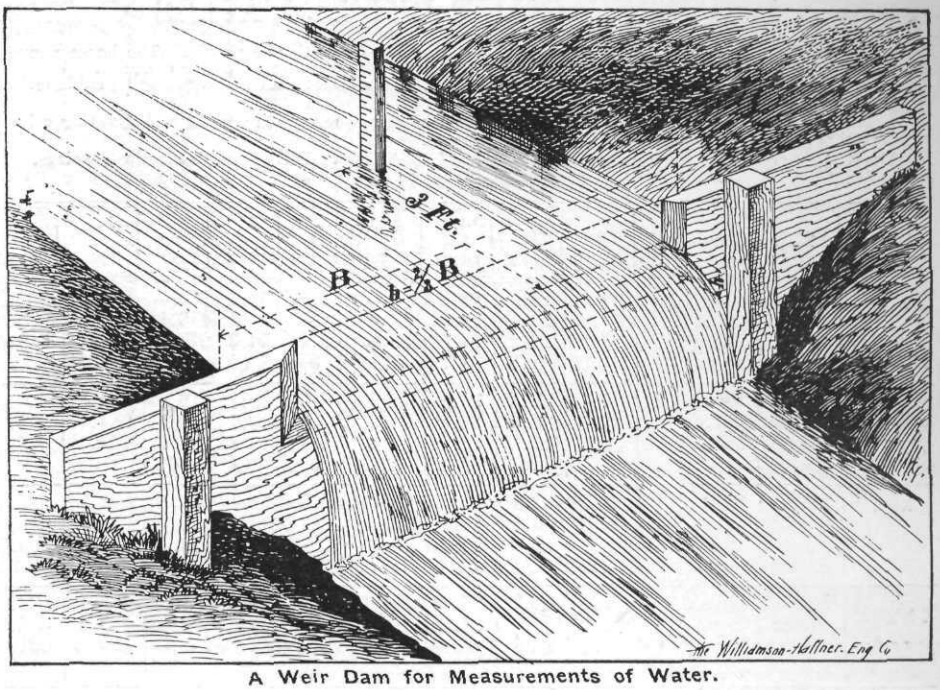
HEAD IN FEET	SIZE OF WHEELS	6 INCH	No. 1 12 INCH	No. 2 12 INCH	18 INCH	24 INCH	3 FOOT	4 FOOT	5 FOOT	6 FOOT
500	Horse Power	7.08	16.55	22.05	49 56	88.02	198.24	352.10	550.89	792.96
	Cubic Feet.....	8.37	19.54	26.08	58.64	104.15	234.56	416.62	651.83	938.25
217 lbs.	Miner's Inches ...	5.23	12.21	17.38	39.09	69.41	156.36	277.64	434.56	625.44
10760.0	*Revolutions*	3597	1798	1798	1199	898	599	449	359	299
520	Horse Power	7.41	20.55	23.10	52.55	93.35	210.33	373.40	584.20	840.92
	Cubic Feet.....	8.43	23.38	26.59	59.80	106.21	239.21	424.87	664.74	956.84
226 lbs.	Miner's Inches ...	5.62	15.58	17.73	39.86	70.81	159.47	283.24	443.16	637.88
10973.0	Revolutions	3666	1833	1833	1223	916	611	457	366	305
540	Horse Power	7.84	21.76	24.76	55.61	98.78	222.47	395.14	618.24	889.90
	Cubic Feet.....	8.59	23.83	27.10	60.94	108.24	243.76	432.96	677.41	975.07
234 lbs.	Miner's Inches ...	5.72	15.84	18.07	40.63	72.16	162.51	288.64	451.61	650.04
11182.1	Revolutions	3739	1869	1869	1246	934	622	467	373	310
560	Horse Power	8.28	22.96	25.44	58.73	104.31	234.94	417.30	652.91	939.79
	Cubic Feet.....	8.75	24.26	27.35	62.06	110.23	248.24	440.91	689.84	992.96
243 lbs.	Miner's Inches ...	5.72	16.17	16.17	41.37	73.48	165.49	293.94	459.89	661.96
11387.3	Revolutions	3705	1902	1902	1268	951	634	475	380	317
580	Horse Power	8.73	24.20	26.15	61.90	109.96	247.65	439.86	688.20	990.61
	Cubic Feet.....	8.90	24.69	27.60	63.16	112.18	252.63	448.71	702.04	1010.54
252 lbs.	Miner's Inches....	5.93	16.46	18.40	42.10	74.78	168.42	299.14	468.03	673.69
11588.8	Revolutions	3874	1936	1936	1291	968	645	484	387	322
600	Horse Power	9.19	25.47	27.56	64.14	115.69	260.56	462.80	724.11	1042.28
	Cubic Feet.....	9.06	25.12	28.09	64.24	114.09	256.95	456.38	714.05	1027.80
260 lbs.	Miner's Inches....	6.04	16.74	18.72	42.82	76.06	171.30	304.24	476.03	685.20
11787.0	Revolutions	3940	1969	1969	1313	984	656	492	393	327
650	Horse Power	10.36	28.71	32.69	73.44	130.46	293.81	521.86	816.50	1175.25
	Cubic Feet.....	9.43	26.14	29.74	69.86	118.75	267.44	475 02	743.21	1069.77
282 lbs.	Miner's Inches....	6.28	17.42	19.82	44.57	79.17	178.29	316.68	495.47	713.18
12268.2	Revolutions	4100	2049	2049	1366	1024	683	512	409	341
700	Horse Power	11.57	32.10	36.54	82.08	145.80	328.36	583.23	912.51	1313.46
	Cubic Feet.....	9.78	27.13	30.85	69.38	123.23	277.54	492.95	771.26	1110.16
304 lbs.	Miner's Inches....	6.52	18.08	20.57	46.25	82.16	185.02	328.63	514.18	740.09
12731.3	Revolutions	4253	2126	2126	1418	1063	708	531	425	353
750	Horse Power	12.84	35.60	40.53	91.03	161.70	364.17	646.83	012.01	1456.70
	Cubic Feet.....	10.12	28.08	31.94	71.82	127.56	287.28	510.25	798.33	1149.13
326 lbs.	Miner's Inches ...	6.75	18.72	21.29	47.88	85.04	191.52	340.16	532.22	766.09
13178.2	Revolutions	4400	2200	2200	1468	1100	733	550	440	366
800	Horse Power	14.14	39.21	44.64	100.29	178.14	401.19	712.59	1114.90	1604.78
	Cubic Feet.....	10.46	29.00	32.99	74.17	131.74	296.70	526.99	824.51	1186.81
348 lbs.	Miner's Inches ...	6.97	19.33	21.99	49.45	87.83	197.80	351.32	549.68	791.21
13610.4	Revolutions	4548	2274	2274	1516	1137	758	569	454	379
900	Horse Power	16.87	46.80	53.27	119.67	212.57	478.73	850.31	1330.37	1914.94
	Cubic Feet.....	11.09	30.76	34.99	78.67	139.74	314.70	558.96	874.53	1258.81
391 lbs.	Miner's Inches....	7.39	20.50	23 32	52.45	93.16	209.80	372.64	583.02	839.20
14436.0	Revolutions	5825	2412	2412	1608	1206	804	602	481	402
1000	Horse Power	19.76	54.81	62.40	140.17	248.97	560.71	995.90	1558.16	2242.84
	Cubic Feet.....	11.69	32.42	36.88	82.93	147.30	331.72	589.19	921.83	1326.91
434 lbs.	Miner's Inches ...	7.79	21.61	24.59	55.29	98 20	221.15	392.79	614.56	884.61
15216.9	Revolutions	5287	2541	2541	1695	1270	847	635	508	423



A Weir Dam for Measurements of Water.

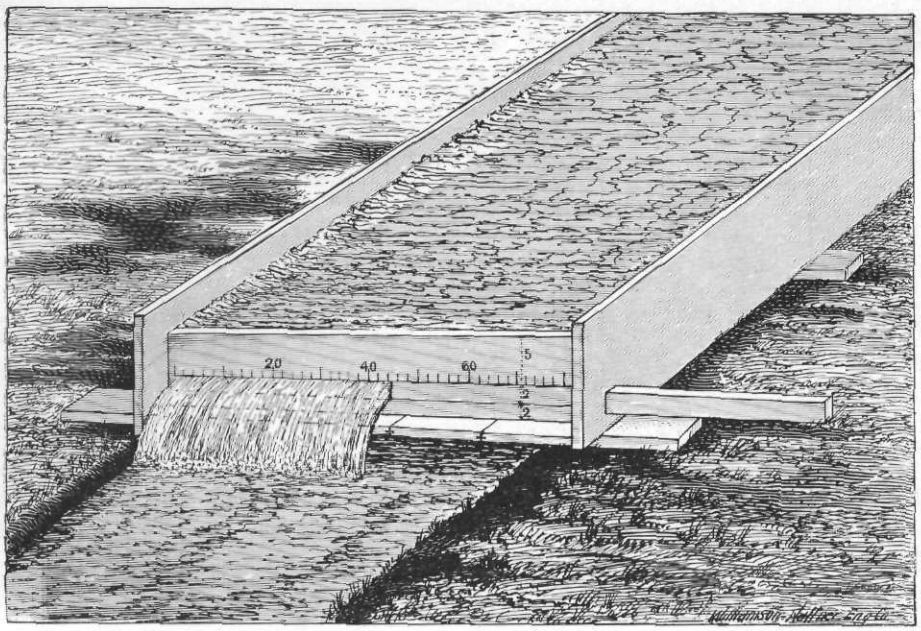
At a point where the stream is moving slowly place a board or plank, as shown in the drawing, this will produce a comparatively quiet body of water. As shown in the drawing, cut an opening in the dam, making the bottom or crest horizontal and the sides vertical; on the down stream side bevel the bottom and side edges at an angle of forty-five degrees, leaving the upstream edges of opening nearly sharp. This opening must be of sufficient capacity to flow the entire stream; no water must be allowed to flow over, under or around the ends of the dam during measurement.

The depth of flow over the weir is the distance from crest to the surface of water above the dam. Proceed as follows to measure this head: In the bed of the stream, five or six feet above the dam, drive a stake till its top is level with crest of weir; alongside of this stake drive another on which to mark the height of water flowing over the weir. Place a rule on top of the first stake and measure the depth of flow to the surface of the water. Length of opening should be from five to ten times the head, and the vertical distance from bottom of opening to bed of stream should be two times the head. A distance of at least six inches should intervene the sides of the opening and banks of the stream.

Having found the depth of flow, the quantity of water passing through the weir in cubic feet will be found by reference to weir dam measurement.

Flow of Water Over Weirs.

Table giving cubic feet of water per minute that will flow over one inch in width of a weir when the head of water over crest of weir is from one-eighth inch to twenty-two inches: (See table on page following.)



Miner's Inch Measurement

The term Miner's Inch is of California origin and varies from 1.35 to 1.75 cubic feet per minute. In modern practice the standard has been adopted that one Miner's Inch equals one and one-half cubic feet per minute. The most common measurement is through an aperture two inches high and any desired length, through a plank one and one-fourth inches thick; quantity of water is determined by the flow through each square inch. The lower end of the aperture is two inches over the bottom of the measuring box, the plank five inches high above the aperture, giving a six-inch head above the center of the stream. The opening is *regulated by means of the sliding bar. Measurement to be taken after the surface of the* water in the box has attained a level with the top of the aperture plank. If a two-inch aperture of convenient length will not flow the water at hand, the height of the aperture can be increased and add to height of plank sufficient to maintain the six-inch head above the center of the aperture.

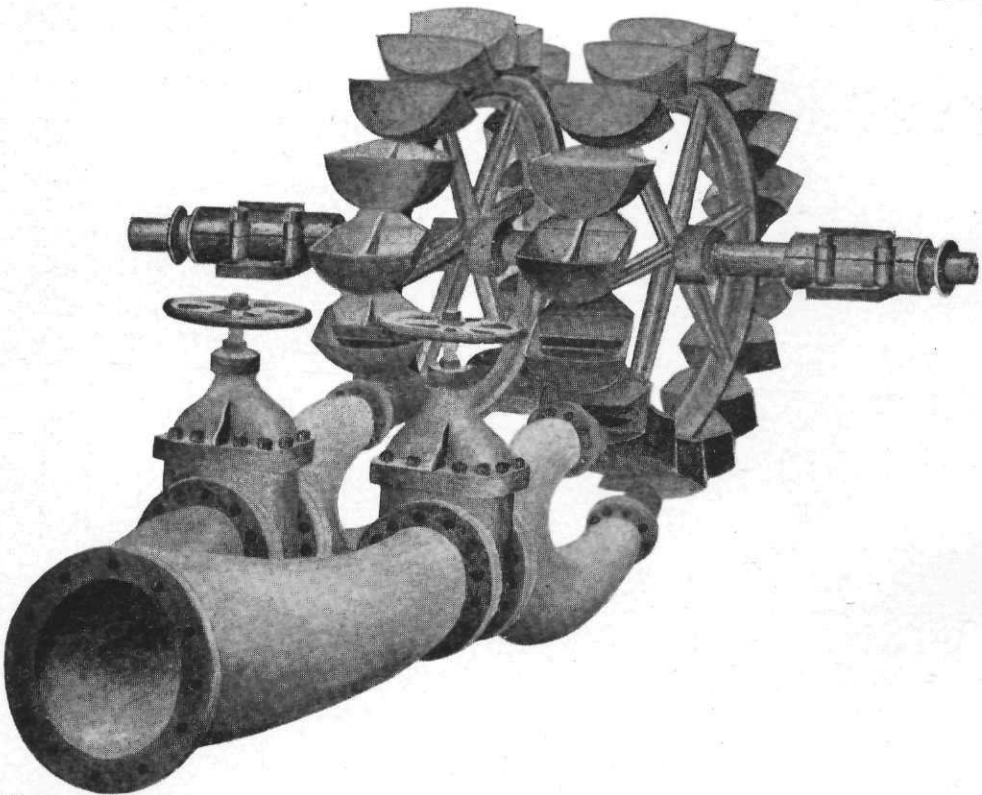
Table showing the discharge in cubic feet per minute of a Miner's Inch of water as measured under the various heads and different lengths and heights of apertures now in general use.

Length of opening in inches	Opening 2 Inches High			Opening 4 Inches High		
	Head to Center, 5 inches	Head to Center, 6 inches	Head to Center, 7 inches	Head to Center, 5 inches	Head to Center, 6 inches	Head to Center, 7 inches
	Cubic Feet	Cubic Feet	Cubic Feet	Cubic Feet	Cubic Feet	Cubic Feet
4	1.348	1.473	1.589	1.320	1.450	1.570
6	1.355	1.480	1.596	1.336	1.470	1.595
8	1.359	1.484	1.600	1.344	1.481	1.608
10	1.361	1.485	1.602	1.349	1.487	1.615
12	1.363	1.487	1.604	1.352	1.491	1.620
14	1.364	1.488	1.604	1.354	1.494	1.623
16	1.365	1.489	1.605	1.356	1.496	1.626
18	1.365	1.489	1.606	1.357	1.498	1.628
20	1.365	1.490	1.606	1.359	1.499	1.630
22	1.366	1.490	1.607	1.359	1.500	1.631
24	1.366	1.490	1.607	1.360	1.501	1.632
26	1.366	1.490	1.607	1.361	1.502	1.633
28	1.367	1.491	1.607	1.361	1.503	1.634
30	1.367	1.491	1.608	1.362	1.503	1.635
40	1.367	1.492	1.608	1.363	1.505	1.637
50	1.368	1.493	1.609	1.364	1.507	1.639
60	1.368	1.493	1.609	1.365	1.508	1.640
70	1.368	1.493	1.609	1.365	1.508	1.641
80	1.368	1.493	1.609	1.366	1.509	1.641
90	1.369	1.493	1.610	1.366	1.509	1.641
100	1.399	1.494	1.610	1.366	1.509	1.642

inches	cubic ft.	1/8 in. cu. ft.	1/4 in. cu. ft.	3/8 in. cu. ft.	1/2 in. cu. ft.	5/8 in. cu. ft.	3/4 in. cu. ft.	7/8 in. cu. ft.
0		.01	.05	.09	.14	.19	.26	.32
1	.40	.47	.55	.64	.73	.82	.92	1.02
2	1.14	1.23	2.35	1.46	1.58	1.70	1.82	1.95
3	2.07	2.21	2.34	2.48	2.61	2.76	2.90	3.05
4	3.20	3.35	3.50	3.66	3.81	3.97	4.14	4.30
5	4.47	4.64	4.81	4.98	5.15	5.33	5.51	5.69
6	5.88	6.07	6.26	6.45	6.63	6.83	7.02	7.22
7	7.41	7.61	7.81	8.02	8.22	8.43	8.64	8.84
8	9.06	9.27	9.48	9.70	9.92	10.14	10.35	10.58
9	10.81	11.03	11.26	11.49	11.72	11.95	12.18	12.42
10	12.65	12.89	13.13	13.37	13.61	13.86	14.10	14.35
11	14.60	14.85	15.10	15.35	15.60	15.86	16.12	16.47
12	16.63	16.89	17.16	17.42	17.68	17.95	18.22	18.48
13	18.75	19.02	19.30	19.57	19.85	20.12	20.40	20.68
14	20.96	21.24	21.52	21.81	22.09	22938	22.66	22.95
15	23.25	23.54	23.85	24.13	24.42	24.72	25.02	25.32
16	25.62	25.92	26.22	26.52	26.82	27.13	27.44	27.74
17	28.05	28.36	28.67	28.99	29.30	29.61	29.93	30.24
18	30.56	30.88	31.20	31.52	31.84	32.17	32.49	32.83
19	33.14	33.47	33.80	34.13	34.46	34.79	35.23	35.46
20	35.79	36.13	36.47	36.80	37.14	37.48	37.82	38.17
21	38.51	38.86	39.20	39.55	39.90	40.25	40.59	40.95
22	41.29	41.64	41.99	42.35	42.79	43.06	43.42	43.78

Find the quantity in cubic feet per minute corresponding to the depth of flow in inches and multiply it by length of weir in inches.

Example: Suppose a weir is 24 inches long and head of flow over the crest is 10½ inches; find 10 inches in the table, run across to column under ½-inch; we find 13.61 cubic feet per minute flows over each inch in width of weir under a head of 10½ inches; the quantity of water that will flow over the weir is 13.61 multiplied by 24 equals 326.64 cubic feet per minute.



Duplex, Double Nozzle, Eight-Foot DeRemer Water Wheels—60-Foot Head, 400 H. P.

TABLES FOR CALCULATING THE HORSE POWER OF WATER.

MINERS INCH TABLE.

The following table gives the Horse Power of one miner's inch of water under heads from one up to one thousand feet. This inch equals 1½ cubic feet per minute.

Heads in Feet	Horse Power	Heads in Feet	Horse Power
1	.0024	320	.7727
20	.0482	330	.7968
30	.0724	340	.8209
40	.0965	350	.8451
50	.1207	360	.8692
60	.1448	370	.8934
70	.1690	380	.9175
80	.1931	390	.9417
90	.2173	400	.9658
100	.2414	410	.9900
110	.2646	420	1.0141
120	.2897	430	1.0383
130	.3139	441	1.0624
140	.3380	450	1.0866
150	.3622	460	1.1107
160	.3893	470	1.1349
170	.4104	480	1.1590
180	.4346	490	1.1832
190	.4507	500	1.2073
200	.4629	520	1.2556
210	.5060	540	1.3039
220	.5312	560	1.3522
230	.5553	580	1.4005
240	.4795	600	1.4488
250	.6036	650	1.5695
260	.6278	700	1.6902
270	.6519	750	1.8110
280	.6761	800	1.9317
290	.7002	900	2.1732
300	.7244	1000	2.4117
310	.7485	....	.....

CUBIC FEET TABLE.

The following table gives the Horse Power of one cubic foot of water per minute under heads from one up to one thousand feet.

Heads in Feet	Horse Power	Heads in Feet	Horse Power
1	.0016	320	.5151
20	.0321	330	.5312
30	.0482	340	.4373
40	.0643	350	.5634
50	.0804	460	.5795
60	.0965	370	.5956
70	.1126	380	.6117
80	.1287	390	.6278
90	.1448	409	.6439
100	.1609	410	.6600
110	.1770	420	.6761
120	.1931	430	.6922
139	.2092	440	.7083
140	.2253	450	.7244
150	.2414	460	.7405
160	.2575	471	.7566
170	.2736	480	.7727
180	.2897	490	.7888
190	.3058	500	.8049
200	.3219	520	.8370
210	.3380	540	.8692
220	.3541	560	.9014
230	.3702	580	.9336
240	.3863	600	.9658
250	.4024	650	1.0463
260	.4175	700	1.1268
270	.4346	750	1.2073
280	.4507	800	1.2878
290	.4668	900	1.4488
300	.4829	1000	1.6998
320	.4990	....	.....

When the Exact Head is Found in Above Table

Example—Have 50 foot head and 100 inches of water. How many Horse Power?

By reference to the above table the Horse Power of 1 inch under 50 feet head is .1207. This amount multiplied by the number of inches 100, will give 12.07 Horse Power.

When Exact Head is Not Found in Table

Take the horse power of 1 inch under one foot head and multiply by the number of inches, and then by the number of feet head. The product will be the required Horse Power.

The above formula applies for the cubic feet table.

Note—The above tables are based upon an efficiency of 85%.

Table of Riveted Hydraulic Pipe

Showing head various sizes of double riveted pipe will stand, weight and price.

Diameter pipe in inches.	Thickness, U. S. standard gauge.	Thickness in inches.	Safe head in feet pipe will stand.	Weight per lineal foot.	Price per lineal foot.	Diameter pipe in inches.	Thickness, U. S. standard gauge.	Thickness in inches.	Safe head in feet pipe will stand.	Weight per lineal foot.	Price per lineal foot.
3	18	.05	814	2.26	$0.20	18	12	.109	298	25.26	$1.90
4	18	.05	610	3.00	.25	18	11	.125	340	29.00	2.10
4	16	.061	763	3.76	.34	18	10	.14	380	32.52	2.39
5	18	.05	487	3.76	.30	18	8	.171	462	40.01	3.00
5	16	.061	608	4.50	.45	20	16	.062	152	16.01	1.26
5	14	.077	760	5.76	.50	20	14	.077	190	19.76	1.54
6	18	.05	407	4.25	.44	20	12	.109	266	27.51	2.10
6	16	.061	508	5.25	.50	20	11	.126	305	31.51	2.24
6	14	.078	633	6.51	.55	20	10	.140	341	35.01	2.50
7	18	.05	348	4.75	.50	20	8	.171	417	45.51	3.40
7	16	.061	435	6.01	.56	22	16	.062	139	17.76	1.40
7	14	.077	543	7.51	.62	22	14	.077	173	22.01	1.70
8	16	.062	380	7.00	.65	22	12	.109	241	30.51	2.24
8	14	.077	472	8.76	.74	22	11	.126	277	34.51	2.40
8	12	.109	663	12.01	.94	22	10	.140	310	39.01	2.80
9	16	.062	337	7.50	.69	22	8	.171	377	50.01	3.75
9	14	.077	422	9.25	.87	24	14	.077	159	23.75	1.80
9	12	.109	589	12.76	1.06	24	12	.109	221	32.01	2.34
10	16	.062	308	8.25	.72	24	11	.126	254	37.51	2.70
10	14	.077	379	10.25	.82	24	10	.140	284	42.01	2.95
10	12	.109	532	14.26	1.00	24	8	.171	347	50.01	3.50
10	11	.126	609	16.26	1.25	24	6	.200	407	59.01	4.30
10	10	.140	683	18.26	1.50	26	14	.077	146	25.51	2.00
11	16	.062	276	9.00	.75	26	12	.109	204	35.51	2.58
11	14	.077	345	11.00	.94	26	11	.126	234	39.51	2.87
11	12	.109	482	15.26	1.25	26	10	.140	262	44.26	3.10
11	11	.125	555	17.51	1.43	26	8	.171	320	54.01	3.85
11	10	.140	620	19.51	1.62	26	6	.200	374	64.01	4.75
12	16	.062	253	10.00	.82	28	14	.077	136	27.26	2.12
12	14	.077	317	12.26	1.00	28	12	.109	189	38.01	2.74
12	12	.109	444	17.00	1.38	28	11	.126	217	42.26	3.00
12	11	.126	508	19.51	1.50	28	10	.140	243	47.51	3.20
12	10	.140	569	21.76	1.68	28	8	.171	297	58.01	4.15
13	16	.062	234	10.51	.90	28	6	.200	347	69.01	5.00
13	14	.077	293	13.00	1.12	30	12	.109	177	39.51	2.90
13	12	.109	409	18.01	1.50	30	11	.126	203	45.01	3.15
13	11	.126	469	20.51	1.65	30	10	.140	227	50.51	3.50
13	10	.140	524	23.01	1.80	30	8	.171	277	61.76	4.30
14	16	.062	217	11.25	.98	30	6	.200	324	73.01	5.24
14	14	.077	272	14.01	1.17	30	¼	.25	403	90.01	6.50
14	12	.109	379	19.51	1.57	36	11	.126	169	54.01	3.80
14	11	.126	435	22.26	1.72	36	10	.140	190	60.51	4.30
14	10	.140	487	25.01	1.94	36	3–16	.187	251	81.01	5.74
15	16	.062	203	11.75	1.00	36	¼	.250	338	109.01	7.60
15	14	.077	253	14.76	1.28	36	5–16	.312	422	135.01	9.50
15	12	.109	353	20.51	1.75	40	10	.140	171	67.51	4.74
15	11	.126	407	23.26	1.95	40	3–16	.187	227	90.00	6.40
15	10	.140	455	26.01	2.10	40	¼	.250	304	120.01	8.40
16	16	.062	192	13.01	1.05	40	5–16	.312	379	150.01	10.50
16	14	.077	238	16.01	1.20	40	⅜	.375	457	180.01	12.00
16	12	.109	333	22.26	1.70	42	10	.140	163	71.00	5.05
16	11	.126	380	24.51	1.84	42	3–16	.187	217	94.51	7.00
16	10	.140	427	28.51	2.00	42	¼	.250	289	126.01	9.50
18	16	.062	170	14.76	1.20	42	5–16	.312	361	158.00	12.00
18	14	.077	211	18.51	1.40	42	⅜	.375	436	190.00	15.00

FLOW OF WATER IN CIRCULAR PIPES, SEWERS, ETC. FLOWING FULL.

(Based on Kutter's Formula, with n=.013.

DISCHARGE IN CUBIC FEET PER SECOND.

Slope, or Head Divided by Length of Pipe.

Diameter	1 in 40	1 in 70	1 in 100	1 in 200	1 in 300	1 in 400	1 in 500	1 in 600
5 inch	456	.344	288	204	166	144	.137	.118
6 "	.762	.576	.482	.341	.278	.241	.230	.197
7 "	1.17	889	744	.526	.430	.372	.355	.304
8 "	1.70	1.20	1.08	.765	.624	.540	.516	.441
9 "	2.37	1.79	1.50	1.06	868	750	.717	.613

Diameter	1 in 60	1 in 80	1 in 100	1 in 200	1 in 300	1 in 400	1 in 500	1 in 600
10 inch	2.59	2.24	2.01	1.42	1.16	1.00	.90	.82
11 "	3.30	2.94	2.63	1.86	1.52	1.31	1.17	1.07
12 "	4.32	3.74	3.35	2.37	1.93	1.67	1.50	1.37
13 "	5.38	4.66	4.16	2.95	2.40	2.08	1.86	1.70
14 "	6.60	5.72	5.15	3.62	2.95	2.57	2.29	2.09

Diameter	1 in 100	1 in 200	1 in 300	1 in 400	1 in 500	1 in 600	1 in 700	1 in 800
15 inch	6.18	4.37	3.57	3.09	2.77	2.52	2.34	2.19
16 "	7.38	5.22	4.26	3.69	3.30	3.01	2.79	2.61
18 "	10.21	7.22	5.89	5.10	4.56	4.17	3.86	3.61
20 "	13.65	9.65	7.88	6.82	6.10	5.57	5.16	4.83
22 "	17.71	12.52	10.22	8.85	7.92	7.23	6.69	6.26

Diameter	1 in 200	1 in 400	1 in 600	1 in 800	1 in 1000	1 in 1250	1 in 1500	1 in 1800
24 inch	15.88	11.23	9.17	7.94	7.10	6.35	5.80	5.29
26 "	19.73	13.96	11.39	9.87	8.82	7.89	7.20	6.58
28 "	24.15	17.07	13.94	12.07	10.80	9.66	8.82	8.05
30 "	29.08	20.56	16.79	14.54	13.00	11.63	10.62	9.69
32 "	34.71	25.54	20.04	17.35	15.52	13.88	12.67	11.57

Diameter	1 in 500	1 in 750	1 in 1000	1 in 1250	1 in 1500	1 in 1750	1 in 2000	1 in 2500
34 inch	25.84	21.10	18.27	16.34	14.92	13.81	12.92	11.55
36 "	30.14	24.61	21.31	19.06	17.40	16.11	15.07	13.48
38 "	34.90	28.50	24.69	22.07	20.15	18.66	17.25	15.61
40 "	40.00	32.72	28.34	25.35	23.14	21.42	20.04	17.93
42 "	45.66	37.28	32.28	28.87	26.36	24.30	22.83	24.41

Diameter	1 in 500	1 in 750	1 in 1000	1 in 1250	1 in 1500	1 in 1750	1 in 2100	1 in 2500
44 inch	51.74	42.52	36.59	32.72	29.87	27.66	25.87	23.14
46 "	58.36	47.65	41.27	36.91	33.69	31.20	29.18	26.10
48 "	65.47	53.46	46.30	41.41	37.80	34.50	32.74	29.28
54 "	89.75	73.28	63.47	56.76	51.82	47.97	44.88	40.14
60 "	118.90	97.09	84.08	75.21	68.65	63.56	59.46	53.18

Diameter	1 in 750	1 in 1000	1 in 1500	1 in 2000	1 in 2500	1 in 3000	1 in 3500	1 in 4000
66 inch	125.20	108.40	88.54	76.67	68.58	62.60	57.96	54.21
72 "	157.80	136.70	111.60	96.66	86.45	78.92	93.07	68.33
78 "	195.00	168.80	137.90	119.40	106.80	97.49	90.26	84.43
84 "	237.70	205.90	168.10	145.60	130.20	118.80	110.00	102 90
90 "	285.30	147.10	201.70	174.70	156.30	142.60	132.10	123.50

For U. S. Gallons, multiply the figures in the table by 7.4805.

LOSS OF HEAD IN PIPE BY FRICTION.

The following tables show the loss of head by friction in each 100 feet in length of different diameters of pipe when discharging the following quantities of water per minute. Applies only to cast iron pipe in good order. Add 20 per cent for wrought iron and steel riveted pipe.

INSIDE DIAMETER OF PIPE IN INCHES.

	1		2		3		4		5		6	
Velo. in feet per second	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute
2.0	2.37	.65	1.185	2.62	.791	5.89	.593	10.4	.474	16.3	.395	23.5
2.2	2.80	.73	1.404	2.88	.936	6.48	.702	11.5	.561	18.0	.468	25.9
2.4	3.27	.79	1.639	3.14	1.093	7.07	.819	12.5	.650	19.6	.547	28.2
2.6	3.78	.86	1.891	3.40	1.26	7.65	.945	13.6	.757	21.3	.631	30.6
2.8	4.32	.92	2.16	3.66	1.44	8.24	1.08	14.6	.864	22.9	.720	32.9
3.0	4.89	.99	2.44	3.92	1.62	8.83	1.22	15.7	.978	24.5	.815	35.3
3.2	5.47	1.06	2.73	4.18	1.82	9.42	1.37	16.7	1.098	26.2	.915	37.7
3.4	6.09	1.12	3.05	4.45	2.04	10.00	1.52	17.8	1.22	27.8	1.021	40.0
3.6	6.76	1.19	3.38	4.71	2.26	10.60	1.69	18.8	1.35	29.4	1.131	42.4
3.8	7.48	1.26	3.74	4.97	2.49	11.20	1.87	19.9	1.49	31.0	1.25	44.7
4.0	8.20	1.32	4.10	5.23	2.73	11.80	2.05	20.9	1.64	32.7	1.37	47.1
4.2	8.97	1.39	4.49	5.49	2.98	12.30	2.24	22.0	1.79	34.3	1.49	49.5
4.4	9.77	1.45	4.89	5.76	3.25	12.90	2.43	23.0	1.95	36.0	1.62	51.8
4.6	10.60	1.52	5.30	6.02	3.53	13.50	2.64	24.0	2.11	37.6	1.76	54.1
4.8	11.45	1.58	5.72	6.28	3.81	14.10	2.85	25.1	2.27	39.2	1.90	56.5
5.0	12.33	1.65	6.17	6.54	4.11	14.70	3.08	26.2	2.46	40.9	2.05	58.9
5.2	13.24	1.72	6.62	6.80	4.41	15.30	3.31	27.2	2.65	42.5	2.21	61.2
5.4	14.20	1.78	7.10	7.06	4.73	15.90	3.55	28.2	2.84	44.2	2.37	63.6
5.6	15.16	1.85	7.58	7.32	5.06	16.50	3.79	29.3	3.03	45.8	2.53	65.9
5.8	16.17	1.91	8.09	7.58	5.40	17.10	4.04	30.3	3.24	47.4	2.70	68.3
6.0	17.23	1.98	8.61	7.85	5.74	17.70	4.31	31.4	3.45	49.1	2.87	70.7
7.0	22.89	2.31	11.45	9.16	7.62	20.60	5.72	36.6	4.57	57.2	3.81	82.4

INSIDE DIAMETER OF PIPE IN INCHES.

	7		8		9		10		11		12	
Velo. in feet per second	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute
2.0	.338	32.0	.296	41.9	.264	53.0	.237	65.4	.216	79.2	.198	94.2
2.2	.401	35.3	.351	46.1	.312	58.3	.281	72.0	.255	87.1	.234	103.
2.4	.468	38.5	.410	50.2	.365	63.6	.327	78.5	.297	95.0	.273	113.
2.6	.540	41.7	.473	54.4	.420	68.9	.378	85.1	.344	103.	.315	122.
2.8	.617	44.9	.540	58.6	.480	74.2	.432	91.6	.392	111.	.360	132.
3.0	.698	48.1	.611	62.8	.544	79.5	.488	98.2	.444	119.	.407	141.
3.2	.785	51.3	.686	67.0	.609	84.8	.549	105.	.499	127.	.457	151.
3.4	.875	54.5	.765	71.2	.680	90.1	.612	111.	.557	134.	.510	160.
3.6	.969	57.7	.848	75.4	.755	95.4	.679	118.	.617	142.	.566	169.
3.8	1.070	60.9	.936	79.6	.831	101.	.749	124.	.680	150.	.624	179.
4.0	1.175	64.1	1.027	83.7	.913	106.	.822	131.	.747	158.	.685	188.
4.2	1.28	67.3	1.122	87.9	.998	111.	.897	137.	.816	166.	.749	198.
4.4	1.39	70.5	1.22	92.1	1.086	116.	.977	144.	.888	174.	.815	207.
4.6	1.51	73.7	1.32	96.3	1.177	122.	1.059	150.	.963	182.	.883	217.
4.8	1.63	76.9	1.43	100.0	1.27	127.	1.145	157.	1.040	190.	.954	226.
5.0	1.76	80.2	1.54	105.	1.37	132.	1.23	163.	1.122	198.	1.028	235.
5.2	1.89	83.3	1.65	109.	1.47	138.	1.32	170.	1.20	206.	1.104	245.
5.4	2.03	86.6	1.77	113.	1.57	143.	1.41	177.	1.28	214.	1.183	254.
5.6	2.17	89.8	1.89	117.	1.68	148.	1.51	183.	1.37	222.	1.26	264.
5.8	2.31	93.0	2.01	121.	1.80	154.	1.61	190.	1.46	229.	1.34	273.
6.0	2.46	96.2	2.15	125.	1.92	159.	1.71	196.	1.56	237.	1.43	283.
7.0	3.26	112 0	2.85	146.	2.52	185.	2.28	229.	2.07	277.	1.91	330.

EXAMPLE.—Have 400 foot head and 300 feet of 10 inch pipe, carrying 150 cubic feet of water per minute. To find effective head. In right hand column under 10 inch pipe, find 150 cubic feet, opposite this will be found the co-efficient of friction for this amount of water, which is 1.059. Multiply this by the number of hundred of feet of pipe, which is 3 and you will have 3.17 feet, which is the loss of head. Therefore the effective head is 400 minus 3.17 equals 396.83.

LOSS OF HEAD IN PIPE BY FRICTION.

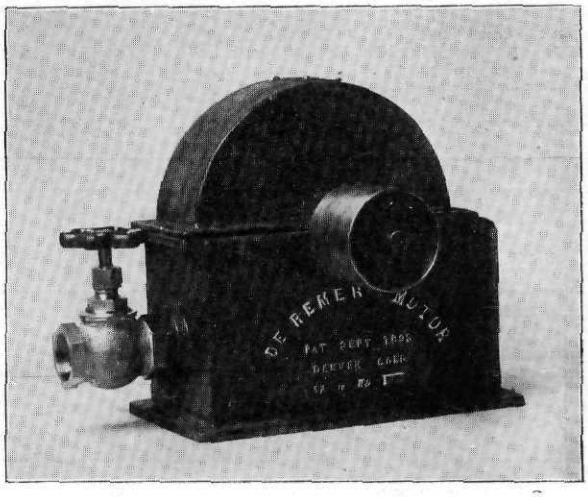
The following tables show the loss of head by friction in each 100 feet in length of different diameters of pipe when discharging the following quantities of water per minute. Applies only to cast iron pipe in good order. Add 20 per cent. for wrought iron and steel riveted pipe.

INSIDE DIAMETER OF PIPE IN INCHES.

	13		14		15		16		18		20	
Velo. in feet per second	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute
2.0	.183	110.	.169	128.	.158	147.	.147	167.	.132	212.	.119	262.
2.2	.216	121.	.200	141.	.187	162.	.175	184.	.156	233.	.140	288.
2.4	.252	133.	.234	154.	.218	176.	.205	201.	.182	254.	164	314.
2.6	.290	144.	.270	167.	.252	191.	.236	218.	.210	275.	.189	340.
2.8	.332	156.	.308	179.	.288	206.	.270	234.	.240	297.	.216	366.
3.0	.375	166.	.349	192.	.325	221.	.306	251.	.271	318	.245	393.
3.2	.422	177.	.392	205.	.366	235.	.343	268.	.305	339.	.275	419.
3.4	.471	188.	.438	218.	.408	250.	.383	284.	.339	360.	.306	445.
3.6	.522	199.	.485	231.	.452	265.	.425	301.	.377	382.	.339	471.
3.8	.576	210.	.535	243.	.499	280.	.468	318.	.416	403.	.374	497
4.0	.632	221.	.587	256.	.548	294.	.513	335.	.456	424.	.410	523.
4.2	.691	232.	641	269.	.598	309.	.561	352.	.499	445.	.449	550.
4.4	.751	243.	698	282.	.651	324.	.611	368.	.542	466.	.488	576.
4.6	.815	254.	757	295.	.707	339.	.662	385.	.588	488.	.529	602.
4.8	.881	265.	.818	308.	.763	353.	.715	402.	.636	509.	.572	628.
5.0	.949	276.	.881	321.	.822	368.	.770	419.	.685	530.	.617	654.
5.2	1.020	287.	.947	333.	.883	383.	.828	435.	.736	551.	.662	680.
5.4	1.092	298.	1.014	346.	.947	397.	.888	452.	.788	572.	.710	707.
5.6	1.167	309	1.083	359.	1.011	412.	.949	469	.843	594.	.758	733.
5.8	1.245	321	1.155	372.	1.078	427.	1.011	486.	.899	615.	.809	759.
6.0	1.325	332.	1.229	385.	1.148	442.	1.076	502.	.957	636.	.861	785.
7.0	1.75	387.	1.63	449.	1.52	515.	1.43	586.	1.27	742.	1.143	916.

INSIDE DIAMETER OF PIPE IN INCHES

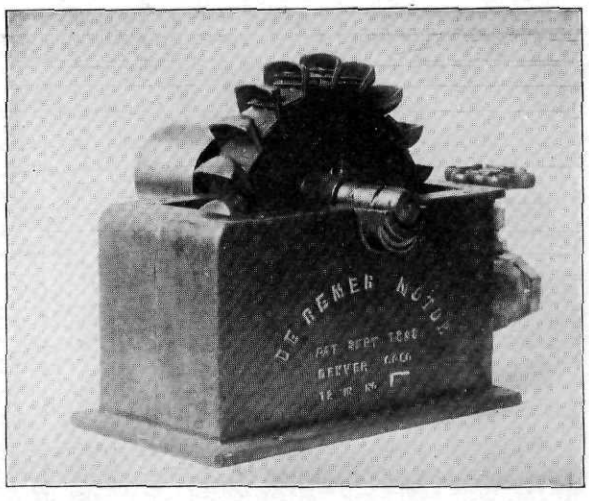
	22		24		26		28		30		36	
Velo. in feet per second	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute	Loss of head in feet	Cubic feet per minute
2.0	.108	316.	.098	377.	.091	442.	084	513.	.079	589.	066	848.
2.2	.127	348.	.116	414.	.108	486.	099	564	.093	648.	.078	933.
2.4	.149	380.	.136	452.	.126	531.	.116	616	.109	707.	.091	1018.
2.6	.171	412.	.157	490.	.145	575.	134	667	.126	766.	.104	1100.
2.8	.195	443.	.180	528.	165	619.	153	718.	.144	824.	.119	1188.
3.0	.222	475.	.204	565.	.188	663.	174	770.	.163	883.	.135	1273.
3.2	.249	507.	.229	603.	211	708.	195	821.	.182	942.	.152	1357.
3 4	.278	538.	255	641.	235	752.	218	872.	.204	1001.	.169	1442.
3.6	.308	570.	.283	678.	.261	796.	.242	923.	.226	1060.	.188	1527.
3.8	.340	601.	.312	716.	.288	840.	.267	974.	.249	1119.	.207	1612.
4.0	373	633.	.342	754.	.315	885.	.293	1026.	.273	1178.	.228	1697.
4.2	.408	665.	.374	791.	.345	929.	.320	1077.	.299	1237.	.249	1782.
4.4	444	697.	.407	829.	.375	973.	348	1129.	325	1296.	.271	1866.
4.6	.482	728.	.441	867.	.407	1017.	.378	1180.	353	1355.	.294	1951.
4.8	.521	760.	.476	905.	.440	1062.	.409	1231.	.381	1414.	.318	2036.
5.0	.561	792.	.513	942.	.474	1106.	440	1283..	.411	1472.	.342	2121.
5.2	.602	823.	.552	980.	.510	1150.	.473	1334.	.441	1531.	.368	2206.
5.4	.645	855.	.591	1018.	.546	1194.	.507	1385.	.473	1590.	.394	2291.
5.6	.690	887.	.632	1055.	.583	1239.	.542	1437.	.506	1649.	.421	2376.
5.8	735	918.	.674	1093.	.622	1283.	.578	1488.	.540	1708.	.450	2460.
6.0	.782	950.	.717	1131.	.662	1327.	.615	1539.	.574	1767.	.479	2545.
7.0	1.040	1109.	.953	1319.	.879	1548.	.817	1796.	.762	2061.	.636	2969.



Twelve-inch Motor.

The illustrations on this page are photographs of the twelve-inch DeRemer Water Wheel that was tested against a twelve-inch Pelton at Cornell University.

The test sheets on the following pages, as well as Prof. Carpenter's letters, explain fully the comparative merits of the two wheels.



Twelve-inch Motor With Cap Removed.

Comparative table of maximum efficiencies and corresponding ratios of velocities of wheel to velocities of water as shown by comparative tests of the DeRemer and Pelton Water Wheels made by Prof. R. C. Carpenter at Sibley College, Cornell University, Ithaca, New York, August, 1899:

DEPARTMENT OF EXPERIMENTING ENGINEERING

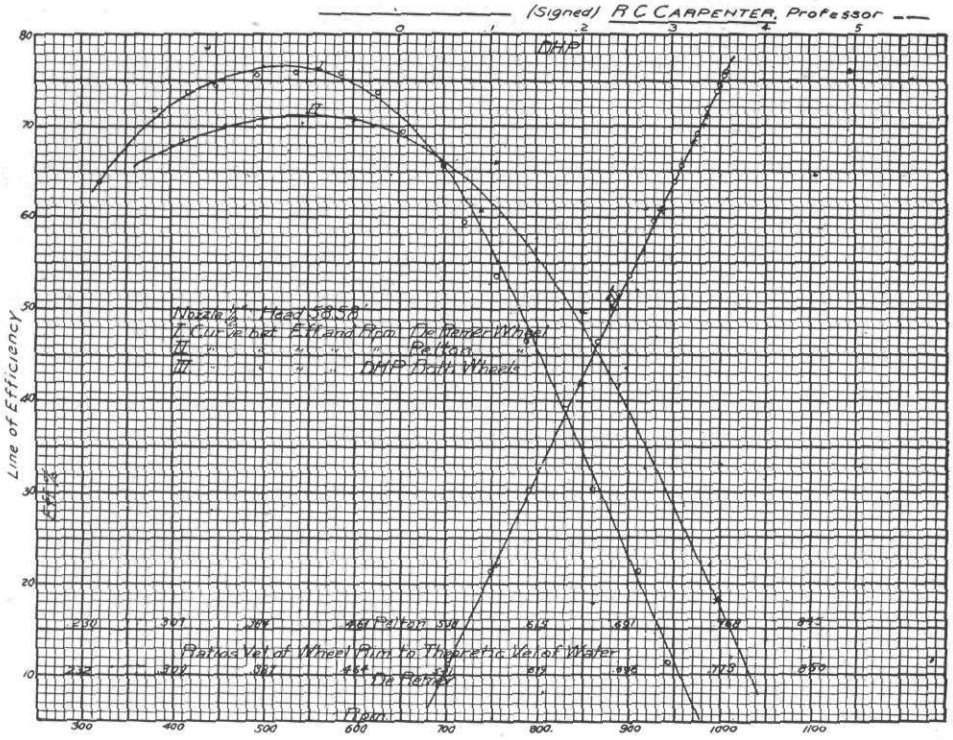
CORNELL UNIVERSITY — ITHACA NEW YORK

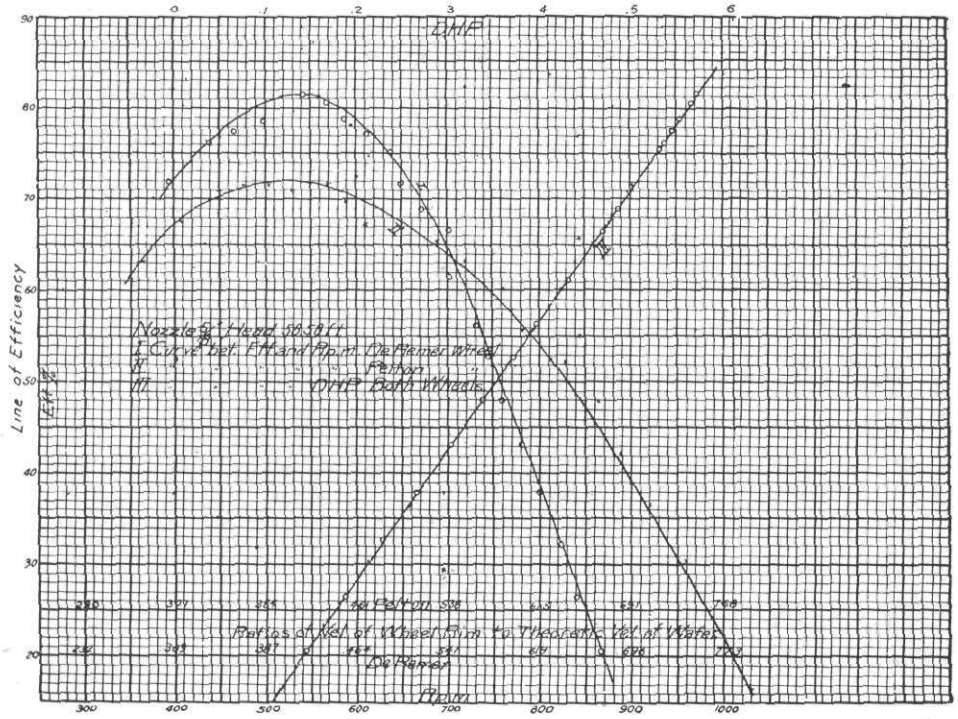
COMPARATIVE TESTS OF THE "DE REMER AND PELTON" WATER-WHEELS

MADE AUGUST 17TH 1899

Under higher Heads a higher Efficiency would be obtained

(Signed) R C CARPENTER, Professor


DHP
Line of Efficiency
Nozzle ½" Head 58.58'
I Curve bet. Eff and Rpm. De Remer Wheel
II " " " " Pelton "
III " " DHP both Wheels
Ratios Vel of Wheel Rim to Theoretic Vel of Water
De Remer
Pelton
Rpm


DHP
Line of Efficiency
Nozzle ⅝" Head 50.38 ft
I Curve bet. Eff and Rp.m. De Remer Wheel
II " " Pelton "
III " " DHP both Wheels
Ratios of Vel. of Wheel Rim to Theoretic Vel. of Water
De Remer
Pelton
Rpm

Efficiencies Per Cent.

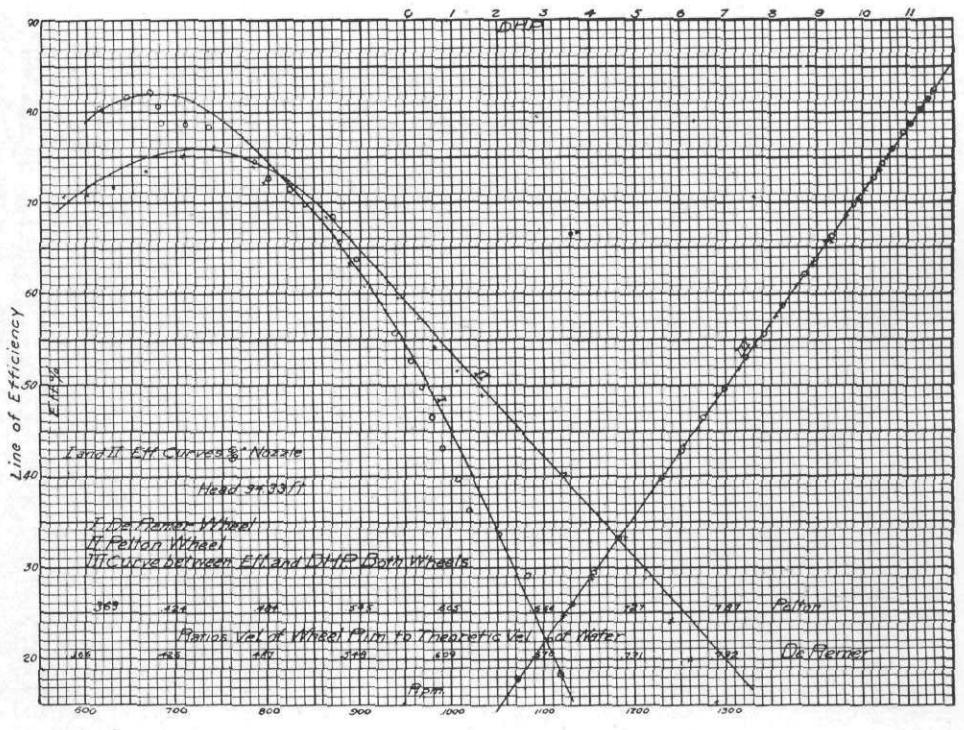
	Pelton.	DeRemer.	Pelton.	DeRemer.
Head in feet	58.58		94.33	
Nozzle ⅜ in.	71.62	70.57		
Nozzle ½ in.	70.86	75.95		
Nozzle ⅝ in.	71.62	81.56	76.04	82.36

Ratio $\frac{V}{V} \frac{P}{D} \frac{W}{H}$

Head in feet	58.58		94.33		154.32	
	Pelton.	DeRemer.	Pelton.	DeRemer.	Pelton.	DeRemer.
Nozzle ⅜ in.	.375	.433			.394	.419
Nozzle ½ in.	.387	.418			.428	.438
Nozzle ⅝ in.	.436	.420	.448	.409		

Maximum D. H. P. and Corresponding Revolutions.

Head in feet	58.58				94.33			
	D.H.P. Pelton.	R.P.M.	D.H.P. DeRemer.	R.P.M.	D.H.P. Pelton.	R.P.M.	D.H.P. DeRemer.	R.P.M.
Nozzle ⅜ in.	.190	488	.187	560				
Nozzle ½ in.	.336	504	.360	540				
Nozzle ⅝ in.	.505	568	.575	544	1.070	740	1.159	672



Sibley College, Cornell University.

"Department of Experimental Engineering,
"R. C. Carpenter, Professor.
"ITHACA, N. Y., Aug. 7, 1899.

"Mr. H. D. Crippen, 120 Liberty St., N. Y.

"Dear Sir:—I beg leave to report on the following additional tests of the DeRemer wheel:

"The conditions of the tests were as follows: The tests were made with one-half inch nozzle in both the DeRemer and the Pelton wheels, each wheel having a nozzle sent by the manufacturer. A uniform head of 142 feet was used. The connections were made as nearly as possible alike, both in regard to length of pipe, number of bends, etc.

"The results were as follows:

"(1) Water turned on both wheels full head, wheels not belted up. Under these conditions speed of Pelton wheel 1,660 revolutions per minute. Speed of DeRemer wheel 1,488 revolutions per minute. Water turned off and belt put on.

"(2) Water turned on Pelton wheel full head. DeRemer wheel shut off. When Pelton had attained full speed water was turned on DeRemer full head. The result was slowing down the Pelton and final stopping, after which neither wheel stirred. Water turned off.

"The wheels were now changed, connecting one in place of the other, so that if there was any advantage in one connection over the other, that advantage would be eliminated. Results now as follows:

"(1) Water turned on both wheels full head, wheels not belted up. Under these conditions speed of Pelton 1,640 revolutions per minute; speed of DeRemer 1,480 revolutions per minute. Water turned off and belt put on.

"Water turned on DeRemer full head. When DeRemer had attained full speed, water turned on Pelton full head. Results were a SLOWING DOWN OF THE DEREMER TO 176 REVOLUTIONS PER MINUTE WHEN IT RAN THE PELTON AGAINST THE STREAM OF WATER AT THAT NUMBER OF REVOLUTIONS. Water turned off.

"Additional data as follows: Distance between centers of shafts of the wheels, as bolted down, three feet six inches. Pulleys five inches in diameter by three-inch face. Belt three and one-half inches wide. The nozzles were previously calibrated and the results show that the PELTON NOZZLE DELIVERED IN A GIVEN TIME SLIGHTLY MORE WATER FOR THE SAME PRESSURE THAN THE DEREMER. This amounts to about ten pounds per minute at a pressure of twenty pounds; thus giving the Pelton slightly greater theoretical horse power for the same pressure on the main. Very truly yours,

(Signed) "R. C. CARPENTER."

In view of the fact that the world has been trying to beat the Pelton wheel one per cent., it would have been more satisfactory had Professor Carpenter expressed in per cent. of efficiency the "slight difference."

The slight difference is represented as follows: The Pelton one-half-inch nozzle under the 142-foot head discharged 7.9 cubic feet, or 443.53 pounds of water per minute. The DeRemer one-half-inch nozzle discharged, as Carpenter says, ten pounds per minute at a pressure of twenty pounds, less than the Pelton. As the wheels were tested under a 142-foot head the pressure was 62.48 pounds. If ten pounds more under twenty pounds pressure was discharged, under the actual pressure of 62.48 pounds the Pelton nozzle discharged 61.24 pounds more than the DeRemer. This represents 7.24 per cent. in efficiency.

The DeRemer wheel that was sent to Cornell University to be tested against the Pelton wheel was confined within a contracted case with the "protector" or water break placed at an angle that caught and drove the discharging water back against the heel of the wheel buckets producing a severe back blow. This was not discovered until after the wheel had arrived at Cornell University. The following extracts from letters will confirm this fact:

Mr. J. J. Crippen, writing from Concord, N. H., June 28, 1899, to me said: "As you mentioned that the wheel was defective I thought it inadvisable to have it tested in competition with the Pelton wheel, but as you are so confident of its superiority, and are willing yourself that this test should be made, I will have it made just as soon as possible."

On the 24th day of December, 1904, I wrote the following to the Secretary of War, Washington, D. C.: "For scientific purposes I would be pleased for information on the following: "If a projectile traveling at a velocity of 3,000 feet per second comes in contact with a stationary steel target and effects a penetration of 10 inches, what would be the penetration if the target was moving in the same direction as the projectile, at half its velocity? To make it less complicated, you can assume that the projectile is a point and that the resistance is uniform throughout." The reply follows: "War Department, Washington, D. C., January 5, 1905. Mr. J. R. DeRemer, Glenwood Springs, Colorado. Sir: Replying to your communication of December 24, 1904, which has been referred to this office, I am directed by the Chief of Ordnance to inform you that it is considered that the penetration of a projectile in the plate under the conditions referred to would be the same as though the projectile struck the plate at a velocity of 1,500 feet per second; this assumes that the plate is traveling at a velocity of 1,500 feet per second, and that its velocity would not be in any way disturbed by the impact of the projectile.

"Respectfully,
"(Signed) T. L. AMES,
"Captain Ordnance Department."

No scientific institution, no nation in the world, has made as extensive experiments as the United States on the results of the impact of moving bodies. If there is any virtue in practical experiment our government should be considered the best authority in the world on these lines.

The application of water under pressure through a jet on a water wheel bucket is precisely the same as the projectile and target: mass or weight, velocity and impact. With a stationary target the projectile has a penetration of 10 inches, but when the target is moving at half the velocity of the projectile the penetration is 5 inches. If a stream is applied to a stationary water wheel bucket and is turned at an angle of 180 degrees 100% results. There is no known law that assumes that the same results will obtain when the bucket is moving at half the velocity of the stream, as claimed by scientists. From the turning point at the bottom of the bucket the water reaction, pressure or push against the outer wall of the concaved sides, when the bucket is moving half the velocity of the stream, exerts an energy of half that when bucket is stationary; this represents 25% of the stream. Admitting that up to the turning point, that point which, theoretically, the stream is "at rest," one-half the energy of the stream is exerted; then we have 50% plus 25%, or 75% maximum possible.

Stop a stream and effect the discharge of the dead water with the least possible friction as is accomplished by the DeRemer bucket, and the nearer will 100% efficiency be obtained. A little practical experimenting on the part of hydraulic engineers will convince them of the truth of my conclusions.

In the application of a hydraulic stream to a water wheel the conditions appear to be universally misunderstood by hydraulic engineers. The vast difference in the results of scientific tests reported for this type of wheel as well as the turbine form, fully corroborate my claims. This is a proposition that should be of interest to every hydraulic engineer in the world.

The following reference to the variable claims made for one of the best known splitter type of water wheels is interesting to say the least: "This construction insures the stream striking the apex and bottoms of the buckets at the proper angle, so that it is directed to right and left, and up the inclined sides of the bucket, while a portion of the stream is directed toward the front and will pass out over the curved front of the bucket and in a **solid body.**" In a solid body—remember this. These conclusions were concurred in by Ross E. Brown, mining and Hydraulic engineer, who conducted an elaborate test of the Pelton water wheel at the University of California. In these tests the highest efficiencies claimed to have been obtained were 82.5 and 82.6%. In conclusion, among other things, Brown said: "The superior efficiencies of the Pelton, as a high head motor, is due to the high efficiency of the circular nozzle." **All tangential water wheels use the circular nozzle.**

In an abstract of a paper read by George J. Henry, Jr., before the Pacific Coast Electric Transmission Association in August, 1902, among other things he said: "The bucket surface and cutting edges must be of a shape which, with a minimum wetting surface, will allow the stream, without crowding at any point, to spread out in a **thin fan-like discharge on each side.**" The inventor, Pelton, and Chief Engineer Brown claim that the discharge of the dead water is made at the sides and in a **solid body,** while Mr. Henry, the present chief engineer, informs us that the discharge must be made at the sides in a **thin fan-like body.** These variable claims warrant the conclusion that some one has been to a guessing school presided over by an incompetent tutor.

Testimonials

Not wishing to burden the public with testimonials, from the many at hand I have selected a few covering the performance of wheels ranging in size from a six (6) inch motor to an eight (8) foot power wheel. These testimonials show that the "little motors" represent the same relatively high efficiency as the large power wheels.

The DeRemer is the only Water Wheel on the market, the wheel rim of which is precisely the same as the Pelton, admitting of the interchange of buckets.

J. R. DEREMER,
Inventor and Patentee.

The first Six-Foot DeRemer Power Wheel was installed at Leland, Oregon, for the Victor Mining Co., No. 2. Mr. Eben Smith of Denver, Colorado, is the President of the company. This wheel was installed and tested for efficiency for the information of The Mine & Smelter Supply Co., Denver, Colorado, who sold it. This firm, one of the largest in the West, had for a number of years held the Denver Agency for the Pelton wheel, but, on receipt of the report of the working of the Leland wheel, discontinued the Pelton agency and accepted the agency for the DeRemer wheel.

LELAND, Oregon, October 17, 1899.

To R. B. McConney, Chief Engineer The Mine & Smelter Supply Co., Denver, Colorado:

Dear Sir:—"The DeRemer wheel is strictly all right; it runs the prettiest of any wheel I ever erected, and I have installed over 300 of different types. Your company will make a great mistake if they do not push it. There is no 'back lash' of the water against the back and sides of the housing; it does business and gets away. It is simply perfect.

(Signed) "L. C. BUCKINGHAM,
"Engineer and Millwright."

DENVER, Colorado, August, 1900.

J. R. DeRemer, 1614 Blake Street, Denver, Colorado:

Dear Sir—The six-foot wheel you installed for us and now successfully running the Kendrick & Gelder smelter at Silverton, Colorado, is working most perfectly. The wheel will easily develop 300 horse power. (Signed) WILLIAM GELDER.

Note—The above wheel was installed and guaranteed 150 horse power.

J. R. DEREMER, Manager DeRemer Water Wheel Co.

MOLINA, Colorado, Jan. 14, 1901.

The DeRemer Water Wheel Co., Denver, Colo.

Gentlemen:—In our experience in water power we have used different styles of water wheels and consider that the DeRemer wheel your company recently installed and now operating our Plateau Valley Roller Mills successfully is the most powerful water wheel in the market. As you know, your wheel displaced a Perfection turbine that was using a world of water, and the DeRemer wheel is doing more and better work with ONE-FOURTH the water.

Your wheel will surely forge to the front regardless of competition. We can not too highly recommend the DeRemer wheel to power users.

(Signed) R. E. FLETCHER,
Manager Plateau Valley Roller Mills.

P. S.—I wish you would send the 2½-inch nozzle, as the ones furnished with the wheel are all too large. (Signed) FLETCHER.

GLENWOOD SPRINGS, Colo., June 20, 1901.

J. R. DeRemer, City.

Dear Sir:—After experimenting several years with various styles of Water Wheels and small stationary engines at a cost of over fifteen hundred dollars ($1,500.00), I saw several of the DeRemer Water Wheels in successful operation and concluded to try one.

I had in operation a twenty-six (26) inch Climax Water Wheel running in connection with a stationary engine. The combined power ran the line shaft 115 to 120 revolutions per minute and the work required the line shaft to run 160 revolutions per minute. An eighteen (18) inch DeRemer Water Wheel displaced the above Water Wheel and steam engine and is running the line shaft 160 revolutions per minute and doing the work in a very satisfactory manner. (Signed) A. E. WITTEMAN,
Propr. Troy Laundry.

IDAHO SPRINGS, Colo., May 7, 1901.

The DeRemer Water Wheel Co., Denver, Colo.

Gentlemen:—The two Pelton Wheels, one five (5) foot and one eight and a half (8½) foot, equipped with the DeRemer Water Wheel Buckets, are "working finely, and are very satisfactory."

THE LITTLE MATTIE MINING, MILLING & POWER CO.

Note.—The above Pelton Water Wheels were not doing the work in hand in a satisfactory manner. Under a guarantee from me that DeRemer wheels would do the work, I was awarded a contract and equipped the Pelton Wheels with DeRemer buckets, with the above result. This performance is a practical illustration of the superiority of the DeRemer Water Wheel over all other Water Wheels in the market.

J. R. DEREMER,
Mgr. DeRemer Water Wheel Co.

GLENWOOD SPRINGS, Colo., Aug. 26, 1901.

Mr. J. R. DeRemer, City.

Dear Sir:—The twelve (12) inch Water Motor you installed in my bottling works is doing the work in a very satisfactory manner. The wheel is capable of running two such plants. You will call to mind that this wheel displaced a Pelton Wheel.

(Signed) ED. S. HUGHES,
Propr. The Glenwood Springs Bottling Works.

GLENWOOD SPRINGS, Colo., May 20, 1901.

J. R. DeRemer, City.

Dear Sir:—The little six-inch DeRemer Water Wheel connected to hydrant is pulling four large ceiling fans and our large coffee mill. The Hot Springs Company charge me ONE DOLLAR PER MONTH for water. This is the cheapest power I ever saw. (Signed) K. C. BENDER,
Prop. Commercial Restaurant.

DENVER, Colorado, August, 1899.

Mr. Wm. M. Davis, Genl. Mgr. The F. M. Davis Iron Works, City:

Dear Sir:—I made a comparative test of the DeRemer and Pelton wheels as directed, and beg leave to report that the result, under prony brake, gave the DeRemer fifteen per cent. higher efficiency than the Pelton. The DeRemer, under favorable conditions, developed 90 per cent. efficiency. I am convinced of the superiority of the DeRemer wheel and recommended that the company arrange for its manufacture.

Yours truly,
(Signed) R. E. HARRINGTON, Chief Engineer.

GLENWOOD SPRINGS, Colorado, August, 1899.

Mr. J. R. DeRemer, City:

Dear Sir:—As requested, I made a comparative test of the DeRemer and Pelton wheels by bolting them down securely, opposing one another, and rigidly belted together. The nozzles were alternated, making the conditions precisely the same.

1—Water turned on both wheels full head. Speed of Pelton, 2,003 revolutions per minute; speed of DeRemer, 2,023 revolutions per minute. Water shut off both wheels and belt put on.

2—Water turned on DeRemer full head and when it had attained maximum speed, water turned on Pelton full head, when the DeRemer slowed down to 540 revolutions per minute, at which speed the DeRemer reversed the Pelton against the stream of water. Water shut off both wheels.

3—Water turned on Pelton full head and when it had attained its maximum velocity, water turned on DeRemer full head, when Pelton slowed down, finally stopped and started in a backward direction, and in a few seconds was being reversed by the DeRemer 540 revolutions per minute.

I have installed many water wheels of different styles, but consider this performance of the DeRemer wheel simply astounding. Yours very truly,

(Signed) THEODORE ROSENBERG,
Civil Engineer.

GLENWOOD SPRINGS, Colorado, January 10, 1904.

Mr. J. R. DeRemer, President The DeRemer Water Wheel Co., Denver, Colorado.

Dear Sir:—I equipped my three (3) foot Pelton water wheel, that is pulling my upper sawmill, with DeRemer water wheel buckets, and was greatly surprised at the increased power developed. This wheel equipped with DeRemer buckets drives the saw through a log that with the Pelton we were compelled to stop and "gig back" two or three times and wait for speed.

We had no gauges whereby to determine the increased power; from the work done there is no question but that the increase was from 10 to 20%.

We have been strong advocates of the Pelton water wheel, but we have changed our minds. Yours very truly,

(Signed) GEORGE BENNETT.

ENCAMPMENT, Wyoming, August 1, 1904.

The Mine and Smelter Supply Co., Denver, Colorado.

Gentlemen:—Regarding the performance of the twelve (12) DeRemer Water Wheels which you installed for our milling, smelting and electric light plants, I beg to say the water wheels are **giving perfect satisfaction,** and are doing the work on a great deal less water than we thought they would at the time of installation. This point alone tells the tale and speaks more for the water wheels than anything I might say regarding them. We are more than satisfied with them Yours respectfully,

(Signed) T. H. TRACY,
General Superintendent.

GRAND JUNCTION, Colorado, Dec. 10th, 1904.

The DeRemer Water Wheel Co, Denver, Colorado.

Gentlemen: We have one of your water motors we purchased through Mr. McKinney. We have added another press to the plant, and we wish to say we consider your wheel the best one on the market to-day, and will do MORE WORK for its size than any we ever saw.

(Signed) THE PELTON ART PRINTING CO.

BURKE, Idaho, May 11, 1904.

The DeRemer Water Wheel Co., Mr. J. R. DeRemer, President, Denver, Colorado.

Gentlemen: We have delayed replying to your favor of the 14th ult., as we wished to get a line on the running of the equipment furnished by yourselves before passing judgment. We are pleased to say that so far as we have been able to judge, the plant is satisfactory.

(Signed) HERCULES MINING CO.,
Per Harry L. Day, Manager.

SALT LAKE CITY, Utah, February 10, 1903.

The Mine & Smelter Supply Co., Agents The DeRemer Water Wheel Co., Salt Lake City, Utah.

Gentlemen:—Relative to the three (3) foot DeRemer Tangential Water Wheel which you furnished us last summer for operating air compressor at the Albion mine, Alta, Utah, are pleased to state that this water wheel has proven highly satisfactory in every way. Our pipe line to the wheel is 10 inches diameter and 1,650 feet long, giving an effective head of 240 feet. By the use of the interchangeable nozzle tips we are enabled to secure all the power we need both at high stage and low stage of water. In fact, your recommendations and design of our entire plant have proven efficient and effective throughout.

Yours very truly,

ALBION MINING CO.,

(Signed) Wm. Hatfield, Manager.

SNIPES, Mesa County, Colorado, Oct. 25, 1903.

Mr. J. R. DeRemer, President The DeRemer Water Wheel Co., Denver, Colorado.

Dear Sir:—I am running your little four-foot water wheel again this winter for Stevens & Fletcher, the Plateau Valley Milling Company, and it is fine and no mistake; pulls this mill to grind forty barrels per day with the small nozzle, 1½ inch and 94 foot head, and does not need touching from morning until night. The wheel is all you can claim for it and more.

Yours respectively,

(Signed) H. D. SMITH, Miller.

CRESTED BUTTE, Colorado, August 2, 1902.

Mr. J. R. DeRemer, President The DeRemer Water Wheel Co., Denver, Colorado.

Dear Sir:—After some delay, I now answer your communication. My "Baby DeRemer" is No. 599. We are running two (2) ore separators with it, and think we could run three (3) or four (4). We have one hundred and twenty (120) pounds pressure.

Separators we are using are ten (10) feet and twelve (12) feet long and six (6) feet wide. We have a DeRemer six (6) inch motor, and it does the work, to the surprise of all who see it. Tell the Mine and Smelter people **she is all they claim for her.**

Yours very respectively,

(Signed) H. T. SMITH.

LAKE CITY, Colorado, May 4th, 1903.

Mr. J. R. DeRemer, President The DeRemer Water Wheel Co., Denver, Colorado.

Dear Sir:—Do you care to sell those large buckets that were brought from the Tobasco mine here? What will you take for them? The Hidden Treasure superintendent wants them. They have all Peltons but one there, and that was part Pelton and part DeRemer till last week. It is to run the dynamo for lighting boarding house, mill, office, etc. **Could get but 85 volts from it.** Some time before, while looking around, I saw some of your buckets, so when the superintendent suggested a larger nozzle, I asked to change buckets; he consented. Left the same nozzle on. Found that your buckets just fit the rim of wheel, showing they belong there. **Now the voltage is 105**—hence the superintendent wants those large ones to put on another wheel. Yours,

(Signed) CHARLES H. MEYER, Electrician.

On the arrival of the plant of DeRemer water wheels for the Hercules Mining Co., Burke, Idaho, Mr. A. W. Sayles wrote to the Mine & Smelter Supply Co., Denver, Colorado, agents for the DeRemer water wheels, and among other things said: "I have installed many water wheels of various types, and will say for this outfit that, as to design, material and workmanship it is the finest I ever saw." "I have installed many DeRemer water wheels, and in each and every case their performance have fully borne out Mr. DeRemer's guarantee of a 'higher efficiency' than can be developed by any other water wheel."

References

Name of Purchaser and Location.	No. of Wheels.	Size of Wheels.	Horse Power.
F. O. Stevens, Glenwood Springs, Colorado	1	6-inch	5
K. C. Bender, Glenwood Springs, Colorado	1	6-inch	5
W. H. Ennen, Glenwood Springs, Colorado	1	6-inch	5
Yewel & Yoorhees, Glenwood Springs, Colorado	1	6-inch	5
A. E. Witteman, Glenwood Springs, Colorado	1	18-inch	15
(Displaced 26-inch Clymax Water Wheel and Stationary Engine.)			
Ed. S. Hughes, Glenwood Springs, Colorado	1	12-inch	10
(Displaced a Pelton Water Wheel.)			
Victor Mining Co. No. 2, Leland, Oregon	1	6-foot	200
(See Expert's report on this wheel with the testimonials.)			
La Veta Mill & Elevator Co., La Veta, Colorado	1	4-foot	100
(Displaced a Leffel Turbine.)			
The Jones Grocery Co., Florence, Colorado	1	6-inch	5
The Jones Grocery Co., Florence, Colorado	1	6-inch	5
The Jones Grocery Co., Florence, Colorado	1	12-inch	10
W. T. Beans, Boulder, Colorado	1	6-inch	5
J. E. Stull, Grand Junction, Colorado	1	6-inch	5
J. E. Stull, Grand Junction, Colorado	1	12-inch	10
The Diamond Mining Co., Great Falls, Montana	1	6-foot	250
The Diamond Mining Co., Great Falls, Montana	2	24-inch	100
Cross & Co., Silverton, British Columbia	1	5-foot	200
Cross & Co., Silverton, British Columbia	3	18-inch	100
Henry Nichols, Grand Junction, Colorado	1	6-inch	5
San Christobal Gold M. & M. Co., Lake City, Colorado	2	8-foot	400
Kendrick & Gelder Smelter, Silverton, Colorado	1	6-foot	300
Plateau Valley Roller Mills, Snipes, Colorado	1	4-foot	100
(Displaced a Perfection Turbine.)			
The Mine & Smelter Supply Co., Denver, Colorado	3	6-foot	1000
The Mine & Smelter Supply Co., Denver, Colorado	1	5-foot	200
The Mine & Smelter Supply Co., Denver, Colorado	1	3-foot	100
The Mine & Smelter Supply Co., Denver, Colorado	5	6-inch	25
The Mine & Smelter Supply Co., Denver, Colorado	4	12-inch	40
The Mine & Smelter Supply Co., Denver, Colorado	4	18-inch	75
The Mine & Smelter Supply Co., Denver, Colorado	1	24-inch	100
The North American Exploration Co., Telluride, Colo	1	3-foot	100
The Colorado Fuel & Iron Co., Redstone, Colo	1	3-foot	100
True, Wells & Co., Cape Nome, Alaska	1	6-foot	300
City Fire Department, Denver, Colorado	1	6-inch	5
Wood Mountain M. & M. Co., Wall Street, Colo	1	5-foot	100
The Little Mattie M. & M. Co., Idaho Springs, Colo	1	5-foot	200
(DeRemer buckets displaced Pelton buckets from Pelton Wheel.)			
The Little Mattie M. & M. Co., Idaho Springs, Colo	1	8½-foot	400
(DeRemer buckets displaced Pelton buckets from Pelton Wheel.)			
Alamo Consolidated Mining Co., Spokane, Wash	1	4-foot	200
Alamo Consolidated Mining Co., Spokane, Wash	1	24-inch	50
Alamo Consolidated Mining Co., Spokane, Wash	1	18-inch	25

Name of Purchaser and Location.	No. of Wheels.	Size of Wheels.	Horse Power.
G. H. Sethman, Denver, Colorado	6	32-inch	800
G. H. Sethman, Denver, Colorado	2	12-inch	10
Chas. C. Moore, Mancos, Colorado	1	12-inch	10
The Bunker Hill Mining Co	1	6-foot	500
J. C. Osgood, Redstone, Colorado	1	12-inch	10
Chas. C. Moore & Co., San Francisco, Cal	2	4-foot	600
Capitol City Power & Mining Co., Capitol City, Colo	1	4-foot	400
The Mine & Smelter Supply Co., Denver, Colorado	2	6-inch	10
The Mine & Smelter Supply Co., Denver, Colorado	2	12-inch	20
The Mine & Smelter Supply Co., Denver, Colorado	2	18-inch	50
The Colorado-Yule Marble Co., Marble, Colo	2	5-foot	800
Hancock, Loving & Roby, Alice, Texas	1	6-foot	500
Gold Ridge Mining Co., Canal Dover, Ohio	1	4-foot	300
Tularosa Copper Co., Tularosa, Mex	1	3-foot	200
Jas. Lytle, Meeker, Colorado	1	12-inch	10
The Gold Ridge Min. Col., Leesburg, Idaho	1	4-foot	300
Mt. Hood Railway & Power Co., Portland, Oregon	1	3-foot	400
The Mine & Smelter Supply Co., Denver, Colorado	3	6-inch	15
The Mine & Smelter Supply Co., Denver, Colorado	4	24-inch	400
The Mine & Smelter Supply Co., Salt Lake City, Utah	1	12-inch	10
The Butterfly-Terrible Mng. Co., Telluride, Colorado	1	12-inch	10
Mount Baker & Yale Mng. Co., Yale, B. C	1	3-foot	200
Mount Baker & Yale Mng. Co., Yale, B. C	1	12-inch	20
Mine & Smelter Supply Co., City of Mexico, Mexico	1	6-foot	400
New York-Nevada Gold Mng. Co., Charleston, Nevada	1	3-foot	100
Thunder Mountain Gold Reef Mining & Development Co., Council, Idaho	1	4-foot	200
The Red Rover G. M. & M. Co., Lake City, Colorado	1	5-foot	500
The Tobasco G. M. & M. Co., Lake City, Colorado	1	5-foot	500

Five years old and installed over 50,000 horse power.

Ten per cent. of our installations under working heads of 500 feet and over, and 3½% under heads from 720 to 1,180 feet. Our best results are under extremely high heads.

Telegraphic Code for the DeRemer Water Wheel

Standard Motors, fully cased and ready to attach to water supply pipe:

6-inch Motor .....Abano
12-inch Motor .....Adair
18-inch Motor .....Africa
24-inch Motor .....Agra
30-inch Motor .....Alamo

Standard One-Nozzle Power Wheels—such as include wheel, shaft, boxes, collars, three nozzle-tips and gate.

3-foot wheel, complete .....Berry
4-foot wheel, complete .....Bean
5-foot wheel, complete .....Boil
6-foot wheel, complete .....Boston
7-foot wheel, complete .....Brazil
8-foot wheel, complete .....Bryan

Standard Two-Nozzle Power Wheels—such as include wheel, shaft, boxes, collars, three nozzle-tips and gate.

3-foot wheel, complete .....Caddo
4-foot wheel, complete .....Cadiz
5-foot wheel, complete .....Calvert
6-foot wheel, complete .....Camden
7-foot wheel, complete .....Correa
8-foot wheel, complete .....Czar

DENOTING HEAD (Fall).

10 Dacca
20 Dallas
30 Darien
40 Darke
50 Darwar
60 Dauphin
70 Davidson
80 Davis
90 Dax
100 Dayton
110 Deal
120 Decatur
130 Deccan
140 Delagoa
150 Delaware
160 Delgade
170 Delhi
180 Delta
190 Denis
200 Denmark
210 Derby
220 Derry
230 Derwent
240 Desha
250 Desoto
260 Detroit
270 Deutz
280 Devenport
290 Devonshire
300 Diest
310 Digne
320 Dinant
330 Dingle
340 Dole
350 Don
360 Doner
370 Donegal
380 Dongola
390 Dort
400 Doubs
410 Douglas
420 Dover
430 Doves
440 Down
450 Downer
460 Downing
470 Drave
480 Draw
490 Dream
500 Drin
510 Dresden
680 Duplin
690 Durance
700 Durango
710 Duren
720 Durham
730 Durlach
740 Dutchess
750 Duval
760 Dwine
770 Dyl
780 Earl
790 Easton
800 Ebora
810 Ebro
820 Eccles
830 Equador
840 Eden

RELATING TO HORSE POWER.

1 Fair
2 Fairfax
3 Falaise
4 Falkirk
5 Falkland
6 Falmouth
7 Falster
8 Falun
9 Fano
10 Faro
15 Fas
20 Fayal
30 Fayette
40 Feejee
50 Femern
60 Fentress
70 Fere
80 Fermo
90 Ferro
100 Fez
110 Fezzan
120 Fife
130 Figeac
140 Fiji
150 Finistere
160 Finland
170 Finmark
180 Fisme
190 Flanders
200 Fleming
210 Florence
220 Flores
230 Flour
240 Florida
250 Flushing
260 Flume
270 Fluvanna
280 Fohr
290 Fog
300 Foix
310 Fondi
320 Fontenay
330 Foolah
340 Forfar
350 Formasa
360 Forsyth
370 Forth
380 Fossano
390 Fowey
400 Foyers
410 Foyle
420 France
430 Francisco
440 Frankfort
450 Franklin
460 Frascati
470 Frederick
480 Freiberg
490 Freising
500 Frejus
600 Freyburg
700 Frome
800 Fulda
900 Fulton
1000 Furth
1500 Fyers

RELATING TO WATER SUPPLY.

Cubic feet per minute.....Galena
We have a maximum supply of.....cubic feet per minute.....Gall
We have a minimum supply of.....cubic feet per minute.....Galway
We have an average of.....cubic feet per minute.....Gap
What is your maximum supply of water in cubic feet per minute?.....Gard
What is your supply of water in miner's inches?.....Gaza
We have.....miner's inches .....Genesee
Can you obtain more water than the amount stated?.....Germany
Can not obtain more water than the amount stated.....Gila
Can the head be increased?.....Glasgow

CUBIC FEET OF WATER PER MINUTE.

5 Babarras
10 Cabell
15 Cabrera
20 Caceres
25 Cahawba
30 Cahir
35 Cahokia
40 Cahors
45 Cairo
50 Calabria
55 Calais
60 Calcutta
65 Caldas
70 Caldwell
75 Calicut
80 California
85 Callao
90 Callaway
95 Calmar
100 Calumet
110 Cambay
120 Campagna
130 Campo
140 Canary
150 Candahar
160 Canoga
170 Cantire
180 Cape
190 Capua
200 Caraman
210 Carbon
220 Cardenas
230 Cardiff

240..... Cardigan
250..... Carinth
260..... Carlisle
270..... Carlow
280..... Carmen
290..... Carnatic
300..... Carolina
310..... Carrik
320..... Carroll
330..... Cartago
340..... Carter
350..... Cassale
360..... Casbin
370..... Casey
380..... Cashel
390..... Cashgar
400..... Caspian
410..... Cassell
420..... Castlebar
430..... Castres
440..... Caswell
450..... Catania
460..... Catawbo
470..... Catskill
480..... Categat
490..... Caucasus
500..... Caubul
510..... Cavan
520..... Cavery
530..... Cayes
540..... Cayuga
550..... Cazen
560..... Cebu
570..... Cecil
580..... Cedar
590..... Ceram
600..... Cerigo
610..... Cervera
620..... Ceylon
630..... Chagres
640..... Chalons
650..... Chambers
660..... Chapel
670..... Charchas
680..... Charlotte
690..... Chautauqua
700..... Chelsea
710..... Chenango
720..... Cher
730..... Cherokee
740..... Chester
750..... Cheviot
760..... Cheyenne
770..... Chicago
780..... Chickapee
790..... Chickasaw
800..... Chicot
810..... Chili
820..... China
830..... Chippeway
840..... Chiswick
850..... Choctaw
860..... Chur
870..... Ciara
880..... Cinaloa
890..... Cintro
900..... Cicars
910..... Civita
920..... Clayton
930..... Cleveland
940..... Clifton
950..... Clydes
960..... Clydesdale
970..... Coanza
980..... Cobu
990..... Cochin
1000..... Codorus
2000..... Cognac
3000..... Cohasset
4000..... Cohoes
5000..... Colberg
6000..... Colne
7000..... Cologne
8000..... Colombia
9000..... Colorado
10000..... Columbus
15000..... Como

NUMBER OF MINER'S INCHES OF WATER AS MEASURED IN WEIR.

5..... Bable
10..... Badajos
15..... Badku
20..... Baeza
25..... *Baffa*
30..... Baffins
35..... Bagdad
40..... Bagneres
45..... Bagnols
50..... Bahamas
55..... Bahar
60..... Bahai
65..... Bahrein
70..... Baikal
75..... Bairout
80..... Baja
85..... Balasore
90..... Balaton
95..... Balbec
100..... Baldwin
110..... Bale
120..... Bali
130..... Balkan
140..... Ballard
150..... Ballina
160..... Ballston
170..... Bally
180..... Baltic
190..... Baltimore
200..... Bamberg
210..... Bamboo
220..... Banca
230..... Banda
240..... Bangkok
250..... Bangor
260..... Bann
270..... Bannacks
280..... Bantam
290..... Baracoa
300..... Barbados
310.....
320..... Barbary
330..... Barbour
340..... Barbuda
350..... Barege
360..... *Bareilly*
370..... Bari
380..... Barinas
390..... Barita
400..... Barletta
410..... Barnaul
420..... Barnegat
430..... Barnsley
440..... Barnwell
450..... Baroach
460..... Baroda
470..... Barre
480..... Barege
490..... Barren
500..... Barrow
510..... Barry
520..... Basel
530..... Basque
540..... Basrah
550..... Bassano
560..... Basse
570..... Bassora
580..... Bastia
590..... Batavia
600..... Baton
610..... Battaglia
620..... Bautzen
630..... Bavaria
640..... Bayazid
650..... Bayeux
660..... Bayonne
670..... Bayou
680..... Bearn
690..... Beaufett
700..... Beauley
710..... Beaune
720..... Beauvais
730..... Beccles
740..... Bedford
750..... Bedouin
760..... Beeder
770..... *Befort*
780..... Beira
790..... Beiroot
800..... Beith
810..... Beja
820..... Belem
830..... Belfast
840..... Belfort
850..... Belgium
860..... Belgrade
870..... Belknap
880..... Belle
890..... Belvidere
900..... Benares
910..... Bengal
920..... Benin
930..... Bensalem
940..... Bensheim
950..... Berar
960..... Berat
970..... Berezoff
980..... Bergen
990..... Bergues
1000..... Berkley
1100..... Berkshire
1200..... Berlin
1300..... Bermudas
1400..... Berne
1500..... Bernard
1600..... Berrine
1700..... Bertie
1800..... Berut
1900..... Berwick
2000..... Beyra
3000..... Bexar
4000..... Bider
5000..... Bingen

DIAMETER OF PIPE IN INCHES.

1 inch..... Labrador	11 inch..... Leyden	21 inch..... Logan
2 " ..... Lehigh	12 " ..... Leyria	22 " ..... London
3 " ..... Leipsic	13 " ..... Liege	23 " ..... Lorain
4 " ..... Leith	14 " ..... Lima	24 " ..... Lot
5 " ..... Lena	15 " ..... Limmat	25 " ..... Louis
6 " ..... Leon	16 " ..... Lingen	26 " ..... Lowell
7 " ..... Lerida	17 " ..... Liria	27 " ..... Loxa
8 " ..... Levant	18 " ..... Lisburn	28 " ..... Lucas
9 " ..... Lewes	19 " ..... Lisle	29 " ..... Ludlow
10 " ..... Liberia	20 " ..... Lodi	30 " ..... Lugo

LENGTH OF PIPE LINE IN FEET.

100 feet..... Megna	800 feet..... Mino	8000 feet..... Montrose
125 " ..... Meigs	900 " ..... Mobile	9000 " ..... Monza
150 " ..... Melrose	1000 " ..... Mogul	10000 " ..... Moore
175 " ..... Melton	1500 " ..... Mohawk	11000 " ..... Morava
200 " ..... Menard	2000 " ..... Molise	12000 " ..... Moaea
225 " ..... Mentz	2500 " ..... Monaco	13000 " ..... Morgan
250 " ..... Mexico	3000 " ..... Mongola	14000 " ..... Morocco
275 " ..... Mersey	3500 " ..... Monroe	15000 " ..... Moscow
300 " ..... Miami	4000 " ..... Montcalm	16000 " ..... Mosul
400 " ..... Midland	4500 " ..... Mont	17000 " ..... Mull
500 " ..... Mifflin	5000 " ..... Monterey	18000 " ..... Munden
600 " ..... Milford	6000 " ..... Monticello	19000 " ..... Munster
700 " ..... Minden	7000 " ..... Montreal	20000 " ..... Muscovy

If the length can not be expressed by one word, use two. Example: Mobile indicates 900 feet and Meigs 125; hence Mobile-Meigs, 1025 feet.

FOR ORDERING WHEEL.

Book order for standard.....wheel under.....feet head, as per catalog.....Nag
Book order for wheel to develop.....h. p. under.....feet head.....Nancy
Construct for mule transportation.....Nankin
Rush the order.....Nanticoke
Ship fully cased wheel.....Nagles
Ship governor with wheel.....Narda
Ship necessary iron work for wood frame.....Nashua
Ship wood frame complete.....Natchez
Ship steel shaft.....inches diameter.....feet long.....Navahoe
Ship pulley.....inch bore.....inches diameter.....inches face.....Nelson
Place pulley on left hand side when facing wheel from nozzle.....Newark
Ship.....extra buckets for.....water-wheel.....Newton

Example:—Ship ten extra buckets for twenty-four-inch water-wheel; which should read: Newton ten Agra.

REMEMBER THAT

The selection of a water power to best utilize the energy of a stream is a problem which involves both practical experience and a knowledge of hydraulics, embracing, as it does, the size of wheel, the strength and dimensions of the conducting pipe, as well as a number of other details. On this account we advise intending purchasers to confer with us and obtain the benefit of our wide experience on these lines. In order to intelligently consider such inquiries, the following information will be required:

DATA FOR PROPOSED WATER POWER PLANT.

From.....

Street No.....

City.....

State.....

1—If installed, give length and size of each section of pipe line.....

.....

.....

2—Amount of water in cubic feet per second.....

3—Head in feet { Net or working head..... / Surveyed or Hydrostatic.....

4—Horse power required—maximum and minimum.....

.....

.....

5—If direct connected, give number of revolutions per minute.....

6—If belt connected, give size and speed of second mover pulley.....

.....

7—State kind of machinery to which wheel will be connected, especially if for electric lighting.....

8—State kind of regulation required, whether governor or hand, or both.....

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Remarks.....

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Follow the above when sending us an inquiry.

MAY 2 1935

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